1988

Statistical evaluation of airport pavement condition survey data for Washington, Oregon, and Idaho.

Weisenburger, Kim

Monterey, California. Naval Postgraduate School

http://hdl.handle.net/10945/23123

Statistical Evaluation
of
Airport Pavement Condition Survey Data
for
Washington, Oregon, and Idaho

by

Kim Weisenburger

A report submitted in partial fulfillment
of the requirements for the degree of

Master of Science in Civil Engineering

University of Washington
1988

TABLE OF CONTENTS

****
****

TABLE OF CONTENTS
****
continued

TABLE OF CONTENTS
****
continued

University of Washington

Abstract

Statistical Evaluation
of
Airport Pavement Condition Survey Data
for
Washington, Oregon, and Idaho

by Kim Weisenburger

Chairman of Supervisory Committee: Professor J.P. Mahoney
Department of Civil
Engineering

This study evaluated pavement condition survey information, provided by the Federal Aviation Administration (FAA), on airport runway pavements from three northwestern states; Washington, Oregon, and Idaho. The study consisted of establishing an runway pavement database, which was based on the pavement's surface characteristics. The two primary pavement surfaces evaluated were flexible pavement (which included AC overlay, bituminous surface treatment, and various maintenance application) and rigid (portland cement concrete). Through statistical analysis regression equations (or models) were developed for prediction future pavement performance and survival statistics for estimating average pavement life. The statistical analysis was performed using the computer software package MINITAB.

The models and survival statistics will assist airport managers, engineers, and maintenance personnel in making the difficult decisions they face regarding pavement design, maintenance, repair and rehabilitation.

LIST OF TABLES

list of tables continued next page

LIST OF TABLES CONTINUED

list of tables continued next page

LIST OF TABLES CONTINUED

LIST OF FIGURES

****
****

list of figures continued next page

LIST OF FIGURES CONTINUED

LIST OF APPENDICES

****
****

PREFACE

Quite often the personnel in charge of running and operating airports, especially in the U.S. Navy, does not have technical backgrounds. Therefore, it was decided that this study would be written in such a manner that a non-engineer or non-technical person would be able to use it.

ACKNOWLEDGMENT

First and foremost, I would like to thank professor Joe P. Mahoney. Without his enthusiasm, guidance, and continuous words of encouragement, this paper might never have been accomplished.

A special thanks to Carol Key of the FAA, who provided the pavement condition survey data used in the study.

Finally, I would like to dedicate this paper as a means of appreciation to my wife Marcia and my children, Richard and Rachelle. They showed great patience and understanding, while I devoted a considerable amount of <u>their</u> time to this study.

ABBREVIATION
LEGEND
****
****

AC	= ASPHALT CONCRETE
B	= BASE
BS	= BITUMINOUS SURFACE
BSB	= BITUMINOUS STABILIZED BASE
BST	= BITUMINOUS SURFACE TREATMENT
CS	= CHIP SEAL
CB	= CINDER BASE
DBST	= DOUBLE BITUMINOUS SURFACE TREATMENT
E	= EMULSION (surface treatment seal coat)
FS	= FOG SEAL or FOG COAT
NWF	= NON-WOVEN FABRIC
OL	= OVERLAY
PFC	= POROUS FRICTION COURSE
PRG	= PIT RUN GRAVEL
PRB	= PIT RUN BASE
PRSB	= PIT RUN SUBBASE
SAND S	= SAND SEAL
SB	= SUBBASE
SC	= SEAL COAT
SS	= SLURRY SEAL
TBST	= TRIPLE BITUMINOUS SURFACE TREATMENT

CHAPTER 1
INTRODUCTION

****

1.1 PURPOSE

The Federal Aviation Administration (FAA) is currently sponsoring and conducting numerous pavement condition surveys on various general aviation and air carrier airports throughout the United States. Up to this point little has been done to evaluate the information and develop models which can be used to predict pavement performance. Therefore, the purpose of this study is to contribute to the FAA national effort in establishing a better understanding of pavement performance by taking a fresh look at in-service pavements and refining the results into "easy to use" models or equations.

The first step in this study will be to establish a database using pavement condition survey information gathered on airport runways from three northwestern states (Washington, Oregon, and Idaho). A thorough review of the database will be followed by the development of pavement performance models and survival statistics. These models and survival statistics will be based on a comparison of comparing pavement features with similar characteristics.

A pavement feature in this text will refer to an airport pavement (facility) such as a runway, taxiway, or apron which has a consistent structural thickness, is made of the same material and was constructed at the same time.

1.2 THE PROBLEM

The basic problem is the lack of adequate pavement performance models or (equations) which are needed to predict pavement performance for a variety of uses. These uses can include:

a) pavement life estimates,

b) relative measures of rehabilitation effectiveness,

c) life-cycle costing,

d) general design decisions,

e) planning decisions, and

f) budget programing.

This information is needed to assist airport managers, engineers, and maintenance personnel in making the difficult decisions they face regarding pavement design, maintenance, repair, and rehabilitation. By having timely identification and early detection of pavement distress, the airport manager will be able to take the necessary corrective action to prolong the airport pavement life.

1.3 BACKGROUND

The Federal Aviation Administration (FAA) established Advisory Circular (AC) 150/5380-6 "Guidelines and Procedures for Maintenance of Airport Pavements" on December 3, 1982, Appendix A [reference 4]. This Advisory Circular (developed by the Army Corps of Engineers) outlines the detailed procedures for performing a pavement condition survey of civil airports and establishing what is known as the Pavement Condition Index (PCI). The pavement condition surveys and determination of the pavement PCI provide the FAA and similarly interested agencies (such as state DOT's and state aeronautics divisions) with important airport pavement data. The three primary objectives of AC 150/5380-6 [1] are:

> (1) "To determine present condition of the pavement in terms of apparent structural integrity and operational surface condition."
>
> (2) "To provide FAA with a common index for comparing the condition and performance of pavements at all airports and also provide a rational basis for justification of pavement rehabilitation projects."
>
> (3) "To provide feedback on pavement performance for validation and improvement of current pavement design, evaluation, and maintenance procedures."

The pavement condition survey evaluates flexible pavements based on sixteen different types of pavement distress, from alligator cracking to rutting. For jointed rigid pavement (portland cement concrete pavement) the pavement condition survey evaluates the pavement on fifteen different types of rigid pavement distress from blow-up to spalling-corners (refer to Appendix A for a complete listing of all the pavement distresses which are considered in the pavement condition survey and used to establish the pavement PCI value).

1.4 SUMMARY

The pavement condition survey data provided by Carol Key of the FAA included information on the runways, taxiways, and aprons of the various airports. However, this study will evaluate and model only the runway pavement portion of the data. It is important to understand that the information to be generated within this study is only a beginning and that there is a vast amount of useful data available which can be taken much further.

CHAPTER 2
RESEARCH METHODOLOGY

****

2.1 INTRODUCTION

As noted earlier, the main object of this study was to develop models (equations) that would provide the airport owner, engineer, and planner, with a much needed planning and decision making tool. These models will provide a quantitative idea of the pavement feature's rate of deterioration and allow for a more realistic life cycle cost analysis relative to new pavement design and rehabilitation decisions. The study will also make some correlations between the different types of repairs used and the associated pavement life. A comparison of the length of time which elapsed from the pavement's initial construction date to the date when the pavement first required repair, will allow the creation of a life-cycle estimate for different pavements. This process of comparing elapsed times will also be used to estimate a life-cycle for bituminous surface treatments and various surface application seal coats such as slurry seals, seal coats, fog seals and emulsion applications. An estimate of age or life for the various pavement features will be obtained by taking the difference

between the date of the original surface treatment application and the date when a succeeding application was applied.

The correlation and regression modeling calculations used in this paper were done with the microcomputer statistical software program called MINITAB (refer to Minitab Handbook [2]). Correlation is a way of measuring the association between two variables and regression takes correlation one step further. Regression analysis generates an equation that can be used to predict the value of one of the variables when the value of the other variable is known.

2.1.1 MODEL CRITERIA There are several key criteria needed in developing reliable pavement models. These criteria include:

(a) A reliable data base.

(b) The inclusion of any variable that can significantly affect the pavements performance.

(c) A usable and functional form of the model.

(d) A model that meets the statistical requirements necessary to be considered accurate within a certain limit.

Modeling is an attempt to replicate the evolution or the past performance of a particular item based on variable inputs. The models presented in this paper will be relatively simple.

They do not address or have inputs for all the variables which contributed to the development of the pavement feature's current condition and PCI value. The PCI values are determined from evaluating a pavement's existing condition, which is undoubtedly a function of variables such as environment, loading, time of construction, materials used, methods of construction, funding policies etc. However, there is simply <u>no easy way</u> to account for all the variables which can and do affect the way different pavements perform. Therefore, all of the above criteria will be strictly adhered to with the exception of (b).

2.1.2 PERFORMANCE VARIABLES As briefly stated above, there are many different variables which influence the performance of airport pavements. Ashford and Wright [9] classified the variables into five groups:

(1) LOAD VARIABLES
- Aircraft gross weight
- Wheel load
- Wheel spacing
- Tire pressure
- Number of load applications
- Duration of the load
- Distribution of the load
- Type of load

(2) ENVIRONMENT
- Annual precipitation
- Temperature
- Aircraft blast and heat
- Fuel spillage

(3) STRUCTURAL
* Number of thicknesses and type of pavement
* Strength of material

(4) CONSTRUCTION VARIABLES

(5) MAINTENANCE VARIABLES

The ideal situation would be to model pavement performance using inputs for each of the above variables. The available data does not make this possible. The variables used in the regression analysis and survival statistics determinations were limited to the pavement physical characteristics (mainly the surface course) and age. These variables are described below:

(a) Pavement Condition Index (PCI): This is a measure of the observed pavement distress (rutting, alligator cracking, raveling, longitudinal and transverse cracking, etc.). Pavement PCI values range from 100 (no distress) to 0 (extensive surface distress). Note, a PCI of 100 or close, normally means the pavement is relatively new and although the scale goes to 0 the pavement actually fails at a rating of 10. Refer to the pavement condition rating scale Figure 3-1, to get an understanding of the range of PCI values and their respective rating.

(b) Age: The pavement age is determined by taking the difference in time between the pavement's original construction, reconstruction or overlay date and the date of the last pavement condition survey or last major surface maintenance or rehabilitation project (depending on the situation).

(c) Structural Section: The pavement structural section is the physical characteristics of the pavement, made up of a surface course, base course, and subbase course (if required). An example of a particular pavement structural section would be two inches of asphalt concrete placed on six inches of base on top of six inches of subbase.

(d) Surface Course: The surface course is the top layer of material making up the pavement structure. The various types of pavement structures are generally described by the type of surface course used. The main purpose of the pavement surface course is to withstand the effects of applied loads, weather, and to continuously provide a smooth, skid-resistant surface. The surface courses reviewed in this study consisted of asphalt concrete (AC), bituminous surface treatments (BST), and portland cement concrete (PCC).

(e) Surface Application Seal Coats: Surface application seal coats will be used to describe surface applications that are normally sprayed on and do not increase the pavement's ability to support a load. The surface application seal coats analyzed included slurry seals, seal coats or chip seals, fog seals, and emulsion applications.

(f) Pavement Feature: The term pavement feature in this study refers to that segment of the runway pavement which was surveyed. The runway pavement segments were determined, based on the pavement's physical characteristics and when it was constructed.

2.1.3 AIRFIELD CONDITION SURVEY The following is a brief outline of the pavement condition survey and the major steps in developing the Pavement Condition Index (PCI).

(a) Determine Present Condition of Pavement
   * Structural condition
   * Operational condition
   * Estimate future condition

(b) Establish a Common Evaluation Procedure
   * Compare condition among different airports
   * Estimate "Pavement Life" for new construction
   * Estimate "Pavement Life" for rehabilitated pavements

(c) Pavement Condition Index (PCI)
   * PCI=100-CDV (CDV = corrected deduct value)
   * PCI=100 (excellent, no distress)
   * PCI=55 (good and assumed usable limit)
   * PCI=10 (failed)
   * PCI=0 (bottom of scale, failed)

2.1.4 PCI STEPS Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5380-6 dated December 3 1982, "Guidelines and Procedures for Maintenance of Airport Pavements"[1], outlines a detailed procedure on how to conduct a pavement condition survey and establish what is known as the pavement condition index (PCI). The following is a brief outline of those procedures used by the FAA to establish the pavement's PCI value for quick reference.

STEP 1: Divide the pavements into FEATURES
   * Runway, taxiway, apron, etc.
   * Consistent structure and materials
   * Age
   * Traffic

STEP 2: Divide each pavement feature into sample units
   * Asphalt surfaced = 5000 sq.ft. sample units
   * PCC surfaced = 20 slabs sample units

STEP 3: Inspect the sample units
   * Distress types
   * Distress severity

* Distress area (density)

STEP 4: Determine the deduct value

STEP 5: Compute the total deduct value for the sample

STEP 6: Adjust the total deduct value (CDV)

STEP 7: Compute the PCI (PCI = 100-CDV)

STEP 8: Compute PCI for feature
* Average PCI's of the sample units

The procedure for conducting pavement condition surveys outlined in AC 150/5380-6 [3] provides for a 95 percent confidence level: that is, the probability that the pavement condition index determined by the random sampling techniques will be within (plus or minus) 5 percent of representing the entire item (pavement feature) being surveyed. The FAA currently recommends and uses a 92 percent confidence factor instead of the 95 percent level specified by the AC. This reduces the amount of area to be inspected.

2.2 RESEARCH OBJECTIVES

Although there were several possible directions for this research project, it was decided that the main purpose of the study would have three primary objectives.

2.2.1 ESTABLISH PCI vs AGE CURVES FOR PAVEMENTS. The first objective will be to develop PCI vs AGE curves for different thicknesses of flexible pavement and portland cement concrete pavements. This will be done first by

using a straight line fit PCI = a + b(AGE), which should provide a close approximation of PCI as a function of AGE. Then, secondly, by using a power or exponential function to get a curved line fit.

2.2.2 ESTABLISH PCI vs AGE CURVES FOR SURFACES OTHER THAN THE ORIGINAL PAVEMENT SURFACE. The second objective will be to develop PCI vs AGE curves for different pavement surface applications commonly used for maintenance or rehabilitation purposes, such as:

(a) New AC overlays

(b) Seal coats

(c) Chip seals

(d) Fog seals

(e) Slurry seals

(f) Emulsion applications

The same modeling approach presented in 2.2.1 above will also be used for the surface applications with PCI as a function of AGE (PCI=f(AGE)).

2.2.3 DEVELOP SURVIVAL STATISTICS FOR THE VARIOUS PAVEMENT FEATURES. Survival statistics as used in this study will refer to estimating how long a particular pavement feature is expected to last based on past performance of similar pavements with like features.

2.3 MODELING OBJECTIVES

The basic idea behind modeling is to establish a set of curves or equations that can be used to relate two or more variables so that one variable (the dependent variable) can be predicted from the others (the independent variables). This report will use regression analysis to develop these pavement performance equations.

The initial objective will be to model pavements with similar characteristics using a straight line regression fit of the data $PCI = a + b(AGE)$. This will provide a basic idea of the best curve (model) fit. The next step will be to model the data using a curved line fit of the data $PCI = a(AGE)^b$. These equations and curves will provide the information needed to predict life cycles for different pavement structures both (new and rehabilitated).

To best illustrate the intent and objectives of this paper, the following example models and figures are provided:

(a) Assume the curve shown in Figure 2-1 is for asphalt concrete (AC) pavement which consists of two inches of AC on six inches of base. It shows three possible curves which might model how this particular pavement performed.

The following is a brief explanation of how the curves can be used, by using the middle or straight line curve as an example. Point A indicates the pavement has a PCI rating of 75 percent after five years. Based on the pavement

condition rating scale and past experience it can be assumed that this particular pavement and aircraft usage (e.g. the Boeing 727) will be usable up to a PCI rating of 55 percent. The curve shows that this pavement will reach a PCI of 55 percent at eight years. The curve provides two pieces of information. First, it indicates that to maintain a PCI rating of at least a 55 percent the pavement will require some type of repair or maintenance in approximately three years. Then, secondly, it implies the pavement has an estimated useful life of eight years. Once again the three curves show the significance of the different types of curve fits that might be expected when modeling the data.

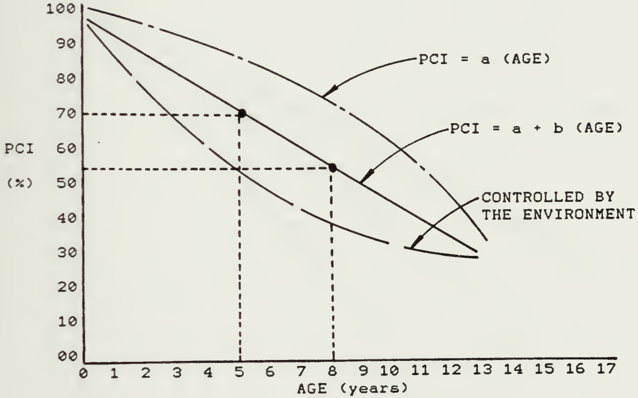


FIGURE 2-1. Example model of three possible PCI vs AGE curves for flexible pavements (two inches of AC on six inches of base).

(b) Another major intent of the paper will be to draw a correlation between different pavement structures and estimated life. That is, develop a set of best fit regression curves which would provide information necessary to predict the best pavement alternative for a given situation. Figure 2-2 shows an example model PCI = a + b(AGE), which plots PCI against age and pavement structure for various pavement thicknesses. This model could be used several ways, but, most importantly, it would allow the decision-maker to estimate how much life each alternative should provide at a particular cost.

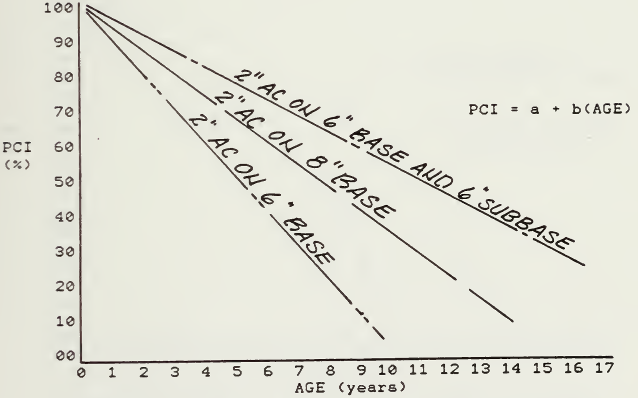


FIGURE 2-2. Example model of PCI vs AGE for flexible pavement with constant AC and varying base thicknesses.

(c) Figure 2-3 shows how asphalt concrete overlays might perform, compared to a newly constructed pavement which includes a two inch AC surface and six inch aggregate base.

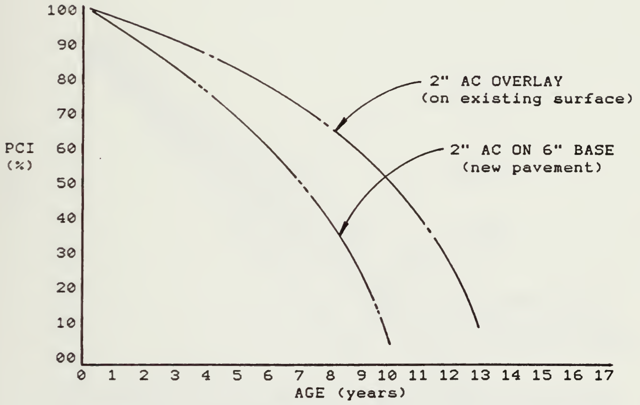


FIGURE 2-3. Example model of PCI vs AGE for flexible pavement (overlay vs new construction).

(d) Another useful application would be a state by state comparison of the PCI vs AGE curves for a particular pavement feature. This state comparison might show that similar pavements do not perform in the same way and that variables such as environment, materials, and construction methods play a major role in how a pavement performs over time. Figure 2-4 is an example of a state by state comparison for Washington, Oregon, and Idaho.

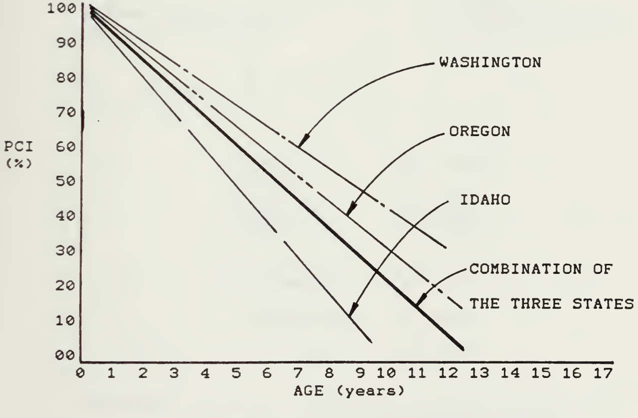
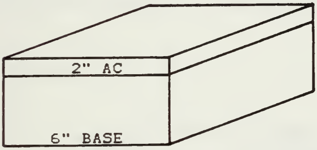


FIGURE 2-4. Example model of PCI vs AGE for flexible pavement (state by state comparison).

(e) Survival statistics is simply the determination of how long the original pavement structure lasted before it required some type of repair or rehabilitation. Figure 2-5 shows a pavement (two inches of AC on six inches of base) with an original construction date of 1972. In 1985 a chip seal was applied to the pavement, therefore this pavement lasted 13 years before it required some type of corrective measures. By having this information from several different airport runways it will be possible to estimate life expectancies for the different types of pavement.



CHIP SEAL (CS)
APPLIED IN 1985

ORIGINAL
CONSTRUCTION
OF PAVEMENT FEATURE
(1972)

PAVEMENT	AGE (YEARS)
RUNWAY #1	13 YEARS
RUNWAY #2	10 YEARS
RUNWAY #3	13 YEARS
*************	**********
3 PAVEMENTS	36 YEARS

AVERAGE AGE = 12 YEARS

(36 YEARS / 3 PAVEMENTS)

FIGURE 2-5. Example calculations for estimating pavement life and developing survival statistics (two inches of AC on six inches of base).

(f) Figure 2-6 uses an example where several data points might come from a single airport. It shows how long a chip seal might last as it is periodically placed on the same surface. This information will help make those critical planning decisions regarding repair costs, timing and alternative selection.

The data shown in Figure 2-6 provides several pieces of information. It indicates that the original pavement had an estimated life of 12 years, that it was constructed in 1968 and received a chip seal in 1980. It indicates that the first chip seal application lasted three years and the second chip seal application lasted five years. By taking the average (estimated) life of four years and adding it to the last chip seal applications one can anticipate that a third chip seal will be required in 1992. This assumes there is no structural failure of the underlying pavement.

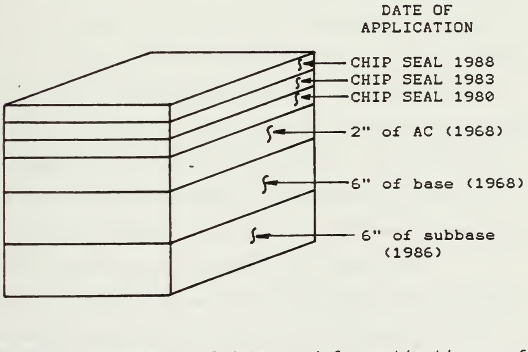


FIGURE 2-6. Example of data used for estimating surface application life and developing survival statistics (chip seal or seal coat).

CHAPTER 3
DATA REVIEW and INTERPRETATION
****

3.1 INTRODUCTION

This chapter provides a brief accounting of the data sources and an explanation of how the data was organized for analysis purposes. There was a considerable amount of information which had to be reviewed to establish the database. An example of a pavement condition survey is provided in Appendix B. The written description of the airports pavement histories and conditions were relatively sketchy. In order to get all the information required to create the runway condition database shown in Appendices C, D, and E, it was necessary to read each of the written descriptions carefully. Also, because the data was sketchy, the information was transcribed verbatim. For instance, when the information indicated a BST being applied to a previously paved surface, the use of a BST was noted, even though the reference was probably to a seal coat.

The PCI information used in this report was obtained from pavement condition surveys conducted primarily on general aviation and commercial airports in the states of Idaho, Oregon, and Washington. There were 142 airports

included in the initial survey, 64 Washington airports (Appendix C), 56 Oregon airports (Appendix D) and 22 Idaho airports (Appendix E). Many of the airports had more than one runway, in fact, this study examined 240 different airport runways. Each runway produced several pieces of information, depending on the number of surface applications; therefore, the exact number of data points considered is unknown. The procedure for conducting the pavement condition survey is outlined in Appendices A and B of AC 150/5380-6, "Guidelines and Procedures for Maintenance of Airport Pavements"[1]. For quick reference, an excerpt from the AC 150/5380-6 (specifically Appendices A and B) is included in Appendix A of this study. For a brief explanation of the airport condition survey and development of the pavement condition index (PCI) refer to Chapter 2 sections 2.1.3 and 2.1.4, respectively.

The pavement condition surveys provide each pavement feature with a PCI rating. The PCI rating is based on pavement distress, such as cracking (longitudinal and traverse) and raveling. However, due to data constraints (lack of complete survey documents) no attempt was made to correlate the PCI value against a particular type of pavement distress in this study. The PCI values were used strictly in an overall pavement rating scenario. Although the PCI data provided by the pavement condition surveys

included information on runways, taxiways, and aprons, this report deals only with the runway PCI information. Each airport had a separate pavement condition survey report. The data consisted of a considerable amount of information and each report had a written description which included such information as:

a) original construction dates,

b) maintenance history,

c) airport layout,

d) climatological data,

e) types of pavement distress, and

f) maintenance recommendations.

Two additional comments need to be made regarding the data and the method in which it was compiled. First, although the pavement condition survey procedures are outlined in detailed, they were conducted by several different consultants and individuals who were asked to use their best JUDGMENT. To compensate for the judgment factor and to add consistency, the FAA trains the individuals who will be conducting the surveys. The FAA reviewed the surveys used in this study and concluded that there was no detectable difference in the work done by the various consultants. In fact, a single individual conducted all the surveys on the Washington and Oregon airports. Even though the FAA

determined that the data was of good quality and worthy of dissemination, it is impossible to estimate what personal bias may have been injected into the surveys; therefore, the data was used in a literal form. The second comment pertains to the treatment of the survey information containing unknowns (UNK). Anytime the runway pavement information contained an UNK or noted an uncertainty, such as no application date, unknown pavement thickness, or unknown surface application, it was omitted from the analysis.

3.2 DATA INTERPRETATION

The basic assumption used in calculating the estimated pavement life was that the original surface treatment was considered acceptable up to the first time it received some type of repair or new surface application. For example, the Sunriver airport, Oregon, was originally constructed in 1970 with a double bituminous surface treatment (DBST). Then, in 1973, the runway received a seal coat (SC) surface application, in 1982 it received a slurry seal (SS) surface application, and in 1985 it received a two inch AC overlay. The two inch AC overlay had a PCI rating of 92 percent when the pavement condition survey was conducted in 1986. By injecting a few assumptions, this information can be used to provide the following data.

(a) One can infer that this particular DBST had a life span of approximately three years.

(b) By using the rule of thumb that airport runway pavements require repair when they reach a PCI of 55 percent, one can concluded that DBST lose approximately 15 PCI percentage points per year (55 percent divided by 3 years). (The above rule of thumb is based on an assumption that will be expanded upon later in this report.)

(c) The information implies that the (SC) lasted approximately nine years (1973 to 1982), before requiring some type of corrective action.

(d) The information implies that (SS) lasted approximately three years (1982 to 1985), before it required maintenance.

(e) The information also provides an estimate of how well the two inch asphalt concrete overlay is holding up since being applied to the existing DBST treated pavement. In this particular example the two inch AC overlay is not holding up very well. It lost eight PCI percentage points in just 1 year. Once again, by using the rule of thumb that 55 percent is the minimum acceptable limit, this two inch overlay should last approximately another four and one half years ((92 percent - 55 percent) divided by (eight percent per year)). What the information does not provide is an explanation of why the AC overlay is deteriorating at the present rate. The poor performance may be due to construction problems.

3.3 DATA REVIEW

There are several key points to follow which will assist in understanding the information presented in the tables. These key points tie directly to the example

provided above. Also, note the following information is only a data breakdown. For the actual ANALYSIS and RESULTS refer to Chapter 4.

(a) Any time the table includes a PCI and AGE column, it can be assumed that the PCI value came from the most recent pavement condition survey and the respective AGE value represents the elapsed time between the date of the survey and the pavement features' last surface application.

(b) When the table includes a PCI and AGE value, the information was used to model a particular pavement feature.

(c) When just an AGE value is given in the table this indicates that there was no PCI value for that particular pavement surface. However, it does not mean that there was not a follow-up application that does have a PCI value. This follow-up surface application would be found in a different table.

(d) One other important feature or word to keep in mind is <u>LIFE</u>. Those tables which only list the pavement feature's AGE represent data that will be averaged and used to estimate that particular pavement features LIFE. Note that the AGE was calculated by taking the elapsed time between each pavement surface application.

(e) There appeared to be some indication that the base thickness may play a part in how well a pavements surface course holds up. Therefore, for quick reference during the analysis stages the respective pavement base thicknesses were included in the tables.

The data was grouped together and reviewed on the bases of the five different pavement characteristics (flexible pavement, AC overlays, bituminous surface treatments, surface maintenance techniques, and portland cement concrete). A brief explanation of these five pavement characteristics and their subsequent subcategories are presented in the following paragraphs.

3.3.1 FLEXIBLE PAVEMENT   Flexible pavements consist of a "Surface Course", a "Base Course", and a "Subbase Course", if required. The surface course is usually constructed with asphalt concrete. However, there are times when a sprayed-on bituminous surface treatments (BST, DBST, TBST) are used (see section 4.3.3). The base course is typically a high quality aggregate, and depending on the design requirements, the aggregate could be treated or untreated, crushed or uncrushed, or any combination of the above. The subbase course, if required, is similar to the base, but usually consists of a lower quality aggregate. The flexible pavement data was subdivided into several different categories:

(a) <u>Two to three inches of AC on six to eight inches of base</u> (TABLE 3-1A). This category contained pavements which had two to three inches of AC on a base between six inches and eight inches thick. The base could be a combination of base and subbase material as long as the total

thickness was no more than 8 inches. Table 3-1A lists those airports which had pavement features that were considered in this category. There were 34 data points used in this category; 12 from Washington airports, 16 from Oregon airports, and 5 from Idaho airports.

(b) Two to three inches of AC on eight inches of base (or thicker) (TABLE 3-1B). The eight inches (or thicker) base could consist of a combination of base and subbase material but it had to total more than 8 inches. Table 3-1B lists those airports which have the above pavement feature. The 27 different data points used for this particular pavement came from 21 airports; 4 Washington airports, 11 Oregon airports, and 6 Idaho airports.

(c) Three inches of AC (or greater) on any base (TABLE 3-1C). In order to keep the data points to a reasonable number, those pavements which had an AC thickness of three inches or larger were considered together. This basically assumes that the thickness of the base and subbase does not greatly affect the pavements performance once the AC is three inches or greater. There were 11 Airports in this category which produced 13 data points. Of the 13 data points, 9 came from Washington airports and 4 from Oregon airports. Table 3-1C lists those airports which have an AC pavement thickness of three inches or more.

(d) Non-World War Two pavement life (TABLE 3-1D). This data concerned all pavements which were constructed sometime after WWII. The pavements were evaluated based on three different AC thicknesses. Table 3-1D shows the three different surface thicknesses which were analyzed.

TABLE 3-1A Flexible pavement AGE and associated PCI values (for two to three inches of AC on six to eight inches of base).

NO.	AIRPORT NAME AND LOCATIONS	AGE (YEARS)	PCI (%)
1	BLAINE MUNICIPAL AP, WASHINGTON	16	72
2	DEER PARK AP, WASHINGTON	10	72
3	ELMA MUNICIPAL AP, WASHINGTON	12	88
4	EVERGREEN FIELD AP, WASHINGTON	20	55
5	EVERGREEN FIELD AP, WASHINGTON	16	86
6	GRAND COULEE DAM AP, WASHINGTON	6	84
7	LAKE CHELON AP, WASHINGTON	2	93
8	NEW WARDEN AP, WASHINGTON	10	77
9	PIERCE COUNTY AP, WASHINGTON	28	64
10	PORT OF ILWACO AP, WASHINGTON	15	71
11	PROSSER AP, WASHINGTON	10	88
12	SEKIU AP, WASHINGTON	16	68
13	SEKIU AP, WASHINGTON	9	88
14	ASHLAND MUNICIPAL AP, OREGON	2	92
15	BANDON STATE AP, OREGON	20	72
16	BEND MUNICIPAL AP, OREGON	9	80
17	BROOKINGS STATE AP, OREGON	18	90
18	BROOKINGS STATE AP, OREGON	18	90
19	COTTAGE GROVE STATE AP, OREGON	22	83
20	COTTAGE GROVE STATE AP, OREGON	18	85
21	COUNTY SQUIRE AIRPARK, OREGON	12	70
22	FLORENCE MUNICIPAL AP, OREGON	3	95
23	HERMISTON MUNICIPAL AP, OREGON	11	87
24	HOOD RIVER AP, OREGON	12	91
25	JOSEPH STATE AP, OREGON	20	72
26	LEBANON STATE AP, OREGON	16	89
27	PACIFIC CITY STATE AP, OREGON	27	79
28	SEASIDE STATE AP, OREGON	23	88
29	TRI-CITIES STATE AP, OREGON	17	88
30	BEAR LAKE COUNTY AP, IDAHO	2	96
31	GOODING MUNICIPAL AP, IDAHO	8	86
32	MC CALL MUNICIPAL AP, IDAHO	12	87
33	OROFINO MUNICIPAL AP, IDAHO	17	81
34	PRIEST RIVER MUNICIPAL AP, IDAHO	11	86

TABLE 3-1B Flexible pavement AGE and associated PCI values (for two to three inches of AC on eight inches of base and subbase or thicker).

NO. AIRPORT NAME AND LOCATIONS	AGE (YEARS)	PCI (PERCENT)
1...ANACORTES AP, WASHINGTON	13	95
2...ANACORTES AP, WASHINGTON	13	100
3...AUBURN MUNICIPAL AP, WASHINGTON	19	81
4...AUBURN MUNICIPAL AP, WASHINGTON	4	90
5...HARVEY FIELD, WASHINGTON	18	64
6...WILLARD-TEKOAN FIELD, WASHINGTON	11	90
7...BAKER MUNICIPAL AP, OREGON	3	88
8...BAKER MUNICIPAL AP, OREGON	3	90
9...BEND MUNICIPAL AP, OREGON	9	89
10..CRESWELL MUNICIPAL AP, OREGON	1	98
11..HOOD RIVER AP, OREGON	1	96
12..HOOD RIVER AP, OREGON	1	95
13..JOHN DAY STATE AP, OREGON	4	93
14..LA GRANDE MUNICIPAL AP, OREGON	12	88
15..MC DERMITT STATE AP, OREGON	1	96
16..ONTARIO MUNICIPAL AP, OREGON	8	84
17..SILETZ BAY STATE AP, OREGON	17	80
18..SPORTSMAN AIRPARK-NEWBERG, OREGON	21	57
19..SUTHERNLIN MUNICIPAL AP, OREGON	16	90
20..ARCO (BUTTE COUNTY) AP, IDAHO	7	66
21..BUHL MUNICIPAL AP, IDAHO	3	69
22..DRIGGS MUNICIPAL AP, IDAHO	11	81
23..JEROME COUNTY AP, IDAHO	5	90
24..MOUNTAIN HOME MUNICIPAL AP, IDAHO	13	70
25..REXBURG (MADISON COUNTY) AP, IDAHO	14	63
26..REXBURG (MADISON COUNTY) AP, IDAHO	9	71
27..REXBURG (MADISON COUNTY) AP, IDAHO	9	61

TABLE 3-1C Flexible pavement AGE and associated PCI values (for three inches of AC and greater, on any base and subbase).

NO.	AIRPORT NAME AND LOCATIONS	AGE (YEARS)	PCI (PERCENT)
1	BOWERS FIELD, ELLENSBURG, WASHINGTON	13	67
2	EPHRATA MUNICIPAL AP, WASHINGTON	4	89
3	KELSO-LONGVIEW AP, WASHINGTON	4	90
4	OLYMPIA AP, WASHINGTON	8	89
5	PANGBORN FIELD-WENATCHEE, WASHINGTON	10	90
6	PULLMAN-MOSCOW REGIONAL AP, WASHINGTON	18	70
7	PULLMAN-MOSCOW REGIONAL AP, WASHINGTON	18	81
8	RICHLAND AP, WASHINGTON	8	86
9	SUNNYSIDE MUNICIPAL AP, WASHINGTON	12	85
10	CHRISTMAS VALLEY AP, OREGON	2	90
11	ROBERTS FIELD, REDMOND, OREGON	11	88
12	ROBERTS FIELD, REDMOND, OREGON	11	91
13	NEWPORT MUNICIPAL AP, OREGON	4	74

(e) <u>World War Two pavement life</u> (TABLE 3-1E). Many of the surveyed airports and their respective runways were constructed during the World War Two (WWII) time period (1942 to 1945). Even though there is a considerable amount of data on these airports, the information is extremely sketchy. As indicated by Table 3-1E several of the runways went 40 years before requiring some form of rehabilitation or repairs. This is not to say the pavement performed well. The respective PCI values and other available information indicate that some corrective action was conducted on the pavement, it was just not properly documented. In fact, on several occasions the surveyor makes mention of similar findings in the written description which outlines the airport pavement's history. Several of the WWII airport descriptions make comments such as "it is very apparent from looking at the existing pavement condition that some sort of surface treatment had been applied, however, there are no records within the files to confirm it". Therefore, in order to accurately estimate pavement performance without biasing the results with WWII data, <u>all</u> WWII data was isolated and addressed as an individual group. Table 3-1E is a list of those WWII airports which were addressed separately. There were several different pavement features identified at each of these Airports.

TABLE 3-1D Flexible pavement life for pavements constructed after World War Two (various pavement thicknesses).

One half to one and one half inches of AC on any base and subbase

NO.	AIRPORT NAME AND LOCATION	AGE (YEARS)
1	PEARSON AIRPARK , WASHINGTON	9
2	PEARSON AIRPARK , WASHINGTON	9
3	CHILOQUIN STATE AP, OREGON	7
4	FLORENCE MUNICIPAL AP, OREGON	17
5	GOLD BEACH MUNICIPAL AP, OREGON	19
6	HERMISTON MUNICIPAL AP, OREGON	18
7	CRAIGMONT MUNICIPAL AP, OREGON	3

Two to two and one half inches of AC on any base and subbase

NO.	AIRPORT NAME AND LOCATION	AGE (YEARS)
1	EPHRATA MUNICIPAL AP, WASHINGTON	10
2	HARVEY FIELD, WASHINGTON	12
3	PROSSER AP, WASHINGTON	4
4	SEKIU AP, WASHINGTON	15
5	SEKIU AP, WASHINGTON	15
6	ALBANY MUNICIPAL AP, OREGON	27
7	BANDON STATE AP, OREGON	6
8	ROSEBURG MUNICIPAL AP, OREGON	35
9	CALDWELL AP, IDAHO	9
10	CALDWELL AP, IDAHO	9
11	GOODING MUNICIPAL AP, IDAHO	7
12	NAMPA MUNICIPAL AP, IDAHO	6
13	SODA SPRINGS AP, IDAHO	14

Three inches of AC on any base and subbase

NO.	AIRPORT NAME AND LOCATION	AGE (YEARS)
1	PULLMAN-MOSCOW REGIONAL AP, WASHINGTON	17
2	PULLMAN-MOSCOW REGIONAL AP, WASHINGTON	17
3	SUNNYSIDE MUNICIPAL AP, WASHINGTON	10
4	GRANGEVILLE (IDAHO COUNTY) AP, IDAHO	18
5	MC CALL MUNICIPAL AP, IDAHO	11

TABLE 3-1E Flexible pavement life for pavements constructed during World War Two (one and one half to three inches of AC on six to eight inches of base).

NO.	AIRPORT NAME AND LOCATION		AGE (YEARS)
1	ARLINGTON MUNICIPAL AP, WASHINGTON		34
2	BREMERTON NATIONAL AP, WASHINGTON	(4 data points)	18*
3	EPHRATA MUNICIPAL AP, WASHINGTON	(2 data points)	37*
4	KENNEWICK-VISTA FIELD, WASHINGTON		34
5	OLYMPIA AP, WASHINGTON		38
6	PULLMAN-MOSCOW REGIONAL AP, WASHINGTON		24
7	RICHLAND AP, WASHINGTON	(2 data points)	36*
8	SANDERSON FIELD,SHELTON ,WASHINGTON		36
9	WILLIAM R FAIRCHILD INT. AP, WASHINGTON	(3 points)	10*
10	BAKER MUNICIPAL AP, OREGON	(2 data points)	21*
11	BOARDMAN AP, OREGON		37
12	BURNS MUNICIPAL AP, OREGON	(2 data points)	26*
13	CORVALLIS MUNICIPAL AP, OREGON		42
14	LA GRANDE MUNICIPAL AP, OREGON		32
15	LAKE COUNTY AP, OREGON		31
16	MADRAS CITY-COUNTY AP, OREGON		18
17	MC MINNVILLE MUNICIPAL AP, OREGON		37
18	NORTH BEND MUNICIPAL AP, OREGON	(4 data points)	9*
19	PENDLETON MUNICIPAL AP OREGON	(2 data points)	20*
20	PENDLETON MUNICIPAL AP OREGON	(3 data points)	36*
21	PORT OF ASTORIA AP, OREGON		36
22	SCAPPOOSE INDUSTRIAL AP, OREGON		43
23	NEWPORT MUNICIPAL AP, OREGON	(2 data points)	40*
24	THE DALLES MUNICIPAL AP, OREGON		22
25	TILLAMOOK AP, OREGON		40
26	TILLAMOOK AP, OREGON		40

* Indicates those airports which provided additional data points at the AGE indicated.

3.3.2 AC OVERLAYS There were 42 data points used in the overlay modeling. They came from 33 different airports which used the asphalt concrete (AC) overlay for repair and rehabilitation purposes. Of the 33 airports, 15 were Washington airports, 16 were Oregon airports and 3 were Idaho airports. The overlays ranged from one inch to three inches and appeared to be the most common method of pavement repair used. Tables 3-2A and 3-2B lists those airport runways which had AC overlays placed on them and were included in the overlay modeling and survival statistics calculations.

TABLE 3-2A Flexible pavement AC overlays one to three inches thick.

NO. AIRPORT NAME AND LOCATIONS	OVERLAY (INCHES)	AGE (YEARS)
1...PULLMAN-MOSCOW REGIONAL AP, WASHINGTON	2	13
2...ASHLAND MUNICIPAL AP, OREGON	2	9
3...LAKE COUNTY AP, OREGON	1.75	11
4...MADRAS CITY-COUNTY AP, OREGON	1	16
5...PENDLETON MUNICIPAL AP, OREGON	3.5	12
6...PENDLETON MUNICIPAL AP, OREGON	3.5	12
7...BURLEY MUNICIPAL AP, IDAHO	2	8

TABLE 3-2B Flexible pavement AC overlays one to ten inches thick.

NO. AIRPORT NAME AND LOCATIONS	OVERLAY (INCHES)	AGE (YEARS)	PCI (PERCENT)
1...ANACORTES AP, WASHINGTON	2"	13	96
2...ARLINGTON MUNICIPAL AP, WASHINGTON	2"	10	89
3...BREMERTON NATIONAL AP, WASHINGTON	3"	13	86
4...BREMERTON NATIONAL AP, WASHINGTON	5"	13	83
5...BREMERTON NATIONAL AP, WASHINGTON	2"	13	88
6...CONNEL CITY AP, WASHINGTON	2"	8	69
7...CREST AP, WASHINGTON	2"	1	97
8...GRAND COULEE DAM AP, WASHINGTON	2"	6	86
9...OAK HARBOR AIR PARK, WASHINGTON	2"	17	73
10..MOSSES LAKE MUNICIPAL AP, WA.	2"	3	89
11..OLYMPIA AP, WASHINGTON	3"	8	86
12..OTHELLO MUNICIPAL AP, WASHINGTON	2"	11	79
13..OMAK AP, WASHINGTON	2.5"	12	68
14..PULLMAN-MOSCOW REGIONAL AP, WA.	2"	14	75
15..RICHLAND AP, WASHINGTON	2"	8	86
16..RICHLAND AP, WASHINGTON	2"	8	84
17..WILLBUR AP, WASHINGTON	2"	1	92
18..WILLIAM R FAIRFIELD INT. AP, WA.	2"	10	94
19..ALBANY MUNICIPAL AP, OREGON	2"	2	99
20..ASHLAND MUNICIPAL AP, OREGON	1"	1	91
21..AURORA STATE AP, OREGON	2"	8	85
22..BOARDMAN AP, OREGON	1.5"	8	57
23..CORVALLIS MUNICIPAL AP, OREGON	3"	4	93
24..FLORENCE MUNICIPAL AP ,OREGON	2"	3	95
25..HERMISTON MUNICIPAL AP, OREGON	2"	11	80
26..ILLINOIS VALLEY AP, OREGON	2"	10	87
27..LA GRANDE MUNICIPAL AP, OREGON	4"	12	72
28..MADRAS CITY-COUNTY AP, OREGON	1"	9	84
29..NORTH BEND MUNICIPAL AP,OREGON	2"	11	90
30..NORTH BEND MUNICIPAL AP,OREGON	2"	11	88
31..NORTH BEND MUNICIPAL AP,OREGON	2"	11	90
32..PINEHURST STATE AP, OREGON	1"	2	83
33..PENDLETON MUNICIPAL AP, OREGON	3"	10	82
34..PENDLETON MUNICIPAL AP, OREGON	5.5"	10	66
35..PENDLETON MUNICIPAL AP, OREGON	10"	10	87
36..NEWPORT MUNICIPAL AP, OREGON	3"	4	91

CONTINUED NEXT PAGE

TABLE 3-2B continued

NO.	AIRPORT NAME AND LOCATIONS	OVERLAY (INCHES)	AGE (YEARS)	PCI (PERCENT)
37..	SUNRIVER AP, OREGON	2"	1	92
38..	TILLAMOOK AP, OREGON	1.5"	4	92
39..	CHALLIS AP, IDAHO	2"	12	79
40..	GRANGEVILLE (IDAHO CO.) AP, IDAHO	2"	3	71
41..	KELLOGG (SHOSHONE CO.) AP, IDAHO	1"	6	94
42..	KELLOGG (SHOSHONE CO.) AP, IDAHO	1"	6	94
43..	KELLOGG (SHOSHONE CO.) AP, IDAHO	3"	6	96
44..	KELLOGG (SHOSHONE CO.) AP, IDAHO	3"	6	93

Note: The Pendleton Municipal Airport runways all had AC overlays placed in 1978. Even though the AC overlays were of different thicknesses, there was no substantial difference in their respective PCI values.

3.3.3 BITUMINOUS SURFACES TREATMENTS (BST) Bituminous surface treatments differ from asphalt concrete pavements; however, they are still considered flexible pavements. A BST pavement consists of a thin layer of Bituminous binder with an imbedded surface course of aggregate (usually 1/2 inch), placed on an aggregate base. By definition, surface treatments are less than 1 inch thick [6]. A BST differs from asphalt concrete in that a BST "does little to increase the ability of the pavement to support loads"[7].

BST applications are used as a wearing and waterproofing surface course. They can be used as a maintenance measure however, " When applied to a previously surface-treated or asphalt- mix paved surface, the asphalt or asphalt-aggregate system is called a seal coat" [6]. This differentiation between a BST and seal coat was not made in the pavement condition surveys. On numerous occasions the data indicated a BST application having been applied to a previously treated surface as a maintenance measure. Although the maintenance BSTs could have been reclassified as seal coats they were not. It was too difficult to assume that the maintenance BST referred to in the data was positively a seal coat. This was because the data also indicated the use of seal coats, sand seals, slurry seals, and porous friction courses along with the maintenance BSTs. In fact, the Roseburg Municipal airport in Oregon shows a BST original construction, a seal coat applied 8 years later, and a BST application 16 years after the seal coat. Therefore, it was assumed that whoever did the survey wanted to make a distinction between BSTs and seal coats. Based on this assumption all BST applications were considered together and analyzed separately from the surface maintenance techniques.

The performance of bituminous surface treatments is in part tied to the thickness of the base, since the base course takes the load. Therefore, the following tables

include the pavement's base course thickness for quick reference. The bituminous surface treatment data was also divided into several different areas which were examined separately. The term BST was used throughout the data along with subsequent terms of DBST (double bituminous surface treatment) and TBST (triple bituminous surface treatment). These terms are somewhat misleading. DBST does not necessarily mean two applications of a BST and likewise for TBST; however, this is how it was used in the data which was provided in the pavement condition surveys. Reference [6] states: "Multiple surface treatments can consist of a series of single surface treatments of the same size aggregate for each layer. More often it is a number of layers of aggregate where each layer consists of aggregate about one-half the size of the previous layer". Therefore, when reading the data, note that three BSTs do not necessarily equal a TBST.

The bituminous surface treatments were subdivided into various categories based on the data provided. Life calculations were performed on those pavements with BST and DBST. However, there were only two airports which had TBST pavements. They were PRU FIELD-RITZVILLE, Washington, with a runway pavement life of 7 years and the CASHMERE-DRYDEN airport, Washington, with a runway pavement life of 15 years.

(a) <u>Bituminous surface treatment (BST)</u> (Table 3-3A). There were 23 data points used to establish the estimated (BST) life. They came from 18 different airports whose names and locations are provided in Table 3-3A (below). The AGE given in Table 3-3A is equal to the years between the initial BST application and any follow-up application to the same surface. Refer to Chapter 4 "ANALYSIS AND RESULTS" for a breakdown of how the data was used. The thickness of the base is included in the table for quick reference.

TABLE 3-3A Bituminous surface treatment (BST) age data.

NO.	AIRPORT NAME AND LOCATION	AGE (YEARS)	BASE (INCHES)
1	CONNEL CITY AIRPORT, WASHINGTON	9	UNK
2	CREST AIRPORT, WASHINGTON	19	UNK
3	DAVENPORT AIRPORT, WASHINGTON	4	8
4	DAVENPORT AIRPORT, WASHINGTON	7*	8
5	FERRY COUNTY, REPUBLIC, WASHINGTON	4	11
6	GRAND COULEE DAM AIRPORT, WASHINGTON	3	6
7	MANSFIELD AIRPORT, WASHINGTON	6	4
8	OKANAGAN LEGION AIRPORT, WASHINGTON	7	2
9	OKANAGAN LEGION AIRPORT, WASHINGTON	18*	2
10	OKANAGAN LEGION AIRPORT, WASHINGTON	7*	2
11	PACKWOOD AIRPORT, WASHINGTON	10	UNK
12	PORT OF WILLIPA HARBOR AP, WASHINGTON	6*	8
13	PORT OF WILLIPA HARBOR AP, WASHINGTON	6*	11
14	QUINCY MUNICIPAL AIRPORT, WASHINGTON	3	3
15	WATERVILLE AIRPORT, WASHINGTON	7	6
16	WHITMAN COUNTY MEMORIAL AIRPORT, WASHINGTON	11	6
17	WILBUR AIRPORT, WASHINGTON	12	6
18	ASHLAND MUNICIPAL AIRPORT, OREGON	12	7.5
19	NEWHALAM BAY MUNICIPAL AIRPORT, OREGON	14	6
20	PROSPECT STATE AIRPORT, OREGON	8	6
21	PINEHURST STATE AIRPORT, OREGON	29	UNK
22	CHALLIS AIRPORT, IDAHO	1	6

* Represent those pavements whose follow-up surface application was a second BST (which will be referred to as a maintenance BST).

(b) <u>Double bituminous surface treatments (DBST)</u> (Table 3-3B). The data also indicates DBSTs being applied during construction and as a surface maintenance application. Refer to Table 3-3B for the location of the airports which currently have DBST surfaces.

TABLE 3-3B Double bituminous surface treatment (DBST) age data.

NO.	AIRPORT NAME AND LOCATION	AGE (YEARS)	BASE (INCHES)
1...	ANACORTES AIRPORT, WASHINGTON	5	7.5
2...	ANACORTES AIRPORT, WASHINGTON	5	7.5
3...	ANACORTES AIRPORT, WASHINGTON	5	7.5
4...	COLVILLE MUNICIPAL AIRPORT,WASHINGTON	9	8
5...	LIND AIRPORT,WASHINGTON	2	3
6...	MOSES LAKE MUNICIPAL AIRPORT,WASHINGTON	13	6
7...	ODESSA MUNICIPAL AIRPORT,WASHINGTON	4	3
8...	ODESSA MUNICIPAL AIRPORT,WASHINGTON	4	3
9...	SUNRIVER AIRPORT, OREGON	3	14

(c) <u>Current PCI ratings BST/DBST/TBST</u> (Table 3-3C). The pavements and airports listed in Table 3-3C represent all the airports which had BST, DBST or TBST as their last surface applications. The AGE is the difference in time between the date the pavement condition survey was conducted when the PCI value was established and the pavement's last surface application. The last surface applications could be anything, from the placement of a slurry seal for water proofing to the construction of the original pavement section.

TABLE 3-3C Bituminous surface treatments (listing of pavement surface treatments BST/DBST/TBST, age from last treatment and current PCI rating).

NO.	AIRPORT NAME AND LOCATION	NO. TREATMENTS	AGE (YEARS)	PCI (%)
1	CASHMERE-DRYDEN AIRPORT, WASHINGTON	(TBST-DBST)	4	72
2	CLE ELUM MUNICIPAL AP, WASHINGTON	(TBST)	1	56
3	CONCRETE MUNICIPAL AP, WASHINGTON	(DBST)	12	61
4	OCEAN SHORES AP, WASHINGTON	(DBST)	1	98
5	ODESSA MUNICIPAL AP, WASHINGTON	(2-DBST)	2	79
6	ODESSA MUNICIPAL AP, WASHINGTON	(DBST-BST)	2	58
7	OKANAGAN LEGION AP, WASHINGTON	(3-BST)	1	76
8	PORT OF WILLIPA HARBOR AP, WASHINGTON	(3-BST)	10	72
9	PORT OF WILLIPA HARBOR AP, WASHINGTON	(3-BST)	10	68
10	QUINCY MUNICIPAL AP, WASHINGTON	(BST)	10	31
11	SEQUIM VALLEY AP, WASHINGTON	(DBST)	3	52
12	STORM FIELD, MORTON, WASHINGTON	(BST-DBST)	1	73
13	WOODLAND STATE AP, WASHINGTON	(TBST)	3	91
14	LEXINGTON AIRPORT,OREGON	(DBST)	2	69
15	NEWHALAM BAY STATE AP, OREGON	(BST-DBST)	8	80
16	WASCO STATE AP, OREGON	(TBST)	2	87

Note: Indicated in the brackets () are the type bituminous surface treatments used (BST, DBST, or TBST) and the number of applications the pavement received; for example, Storm Field was constructed with BST and then received a DBST as a maintenance measure one year later. The last DBST currently has a PCI of 73.

The data will be evaluated to see if any pavement similarities exist. The of use a BST, DBST, or TBST as a maintenance measure is extremely unlikely, indicating that this data may be somewhat misleading. The various surface treatments probably should have been designated as seal coats in the survey data since they were used as maintenance techniques vs new construction. This issue will be discussed later in the study.

3.3.4 SURFACE MAINTENANCE APPLICATIONS AND TECHNIQUES

Surface maintenance applications are normally sprayed-asphalt surface treatments and are used for reasons other than improving the structural capabilities of the pavement. Most

commonly they are used on existing pavements as a method of improving or restoring the pavements' waterproof and skid-resistance surface, and to reduce surface distress caused by oxidation of the asphalt. Surface maintenance techniques, or surface seal applications, refer to the different types of surface seals applied to the runway pavements as <u>maintenance measures</u>. The two terms will be used interchangeably throughout the paper. By definition, surface seal coats refer to maintenance measures and bituminous surface treatments refer to original construction and therefore will be addressed separately.

The pavement condition surveys indicated that there were six basic types of surface seal applications used as maintenance techniques to improve existing pavement surface conditions.

(1) SLURRY SEALS (SS)

(2) SEAL COATS (SC)

(3) CHIP SEALS (CS)

(4) FOG SEALS (FS)

(5) EMULSION APPLICATIONS (E)

(6) CRACK SEALS

Several of the surface maintenance techniques used were combined based on their similarities. Seal coats and chip seals are basically the same thing and were combined into one category called Seal Coats (SC). Fog seals and emulsion

applications are very similar also. Therefore, they were combined into a single category and will be referred to as Fog Seals (FS).

The fog seal applications will be looked at separately even though there were very few cases of their use. Because fog seal and emulsion applications do little to change a pavement's characteristics, they were not considered when calculating surface treatment LIFE. For example, if a two inch overlay placed in 1975 had a fog seal applied in 1978 and then had a slurry seal placed in 1980, the fog seal would be ignored and the life of the overlay would be estimated at five years.

Crack seal life and performance characteristics were not evaluated in this study. Crack sealing is only applied to selected portions of the pavement feature. Therefore, it was assumed that the crack sealing applications do not greatly affect the pavement's PCI rating and that they could be omitted from the study without impacting on the results. This is not to say crack sealing is not important.

The various asphalt surface applications or maintenance seals made up a considerable amount of the information provided by the pavement condition surveys. The following sections and tables will assist in clarifying how the surface maintenance techniques were combined and used in the analysis. Note, much of it required interpretation. Since

the underlying pavement structure plays a key role in how the various asphalt surface maintenance techniques performed, all the tables presented in this section will include the pavement's last surface maintenance application. The PCI and AGE values listed were obtained in the same fashion as presented earlier. The PCI value is the PCI rating at the time of the survey and the AGE is the difference in time between the date of the initial surface seal application and the date of the pavement condition survey.

(a) Slurry seals (Table 3-4A). This category includes all pavements which had slurry seal applications. There were five airports which used slurry seals as an initial maintenance measure and then required an additional surface application.

TABLE 3-4A Surface maintenance techniques (airport runways used to estimate slurry seal life).

NO.	AIRPORT NAME AND LOCATIONS	AGE (YEARS)	PREVIOUS SURFACE
1	....CASHMERE-DRYDEN AP, WA	3	SC
2	....CASHMERE-DRYDEN AP, WA	5	SS
3	....GRAND COULEE DAM AP, WA	5	BST
4	....LIND AP, WA	9	DBST
5	....MOSES LAKE MUNICIPAL AP, WA	10	DBST
6	....SUNRIVER AP, OR	3	SC

Note: "A slurry seal is a mixture of well-graded fine aggregate, mineral filler (if needed), emulsified asphalt, and water applied to a pavement as a surface treatment"[6].

(b) Seal coats (Table 3-4B). The seal coat data consist of 10 data points from eight different airports. The previous surface in Table 3-4B also refers to the surface on which the seal coat was applied. The pavement condition survey indicated that the Oak Harbor airport's original surface course was a seal coat application. Under normal circumstances one would assume that they really meant BST applications. However, rather than interpreting the data, the seal coat is shown as a SC in Table 3-4B, but not included in the actual analysis calculations.

TABLE 3-4B Surface maintenance techniques (airport runways used to estimate seal coat life).

NO.	AIRPORT NAME AND LOCATIONS	AGE (YEARS)	PREVIOUS SURFACE
1	....CASHMERE-DRYDEN AP, WA	5	TBST
2	....OAK HARBOR AIR PARK, WA	2	ORIGINAL
3	....MANSFIELD AP, WA	4	BST
4	....ODESSA MUNICIPAL AP, WA	11	DBST
5	....ODESSA MUNICIPAL AP, WA	11	DBST
6	....WILBUR AP, WA	2	BST
7	....BURNS MUNICIPAL AP, OR	10	SC
8	....BURNS MUNICIPAL AP, OR	10	SC
9	....PROSPECT STATE AP, OR	16	BST
10	...SUNRIVER AP, OR	9	DBST

Note: A seal coat is a thin layer of asphalt-aggregate ranging in thickness from one and one half and three quarters of an inch.

(c) Fog seals (Table 3-4C). All the data on the fog seals came from airports in Idaho. In fact, the Washington State's data never mentions the use of fog seals. Oregon's data indicates two uses of fog seals but they were the pavement's last surface application and can not be used for estimating life.

TABLE 3-4C Surface maintenance techniques (airport runways used to estimate fog seal life).

NO.	AIRPORT NAME AND LOCATIONS	AGE (YEARS)	PREVIOUS SURFACE
1	....CALDWELL AP, ID	2	2"AC
2	....CALDWELL AP, ID	2	2"AC
3	....CRAIGMONT MUNICIPAL AP, ID	5	1"AC
4	....JEROME COUNTY AP, ID	3	7.5"AC
5	....NAMPA MUNICIPAL AP, ID	3	2"AC

Note: Fog seals are "a very light application of diluted, slow-setting asphalt emulsion"[6].

(d) PCI comparison of maintenance techniques (Table 3-4D). This table lists those pavements whose last surface application was a surface seal applied as a maintenance measure. The PCI values appeared to be very inconsistent. To help make some sense out of the erratic PCI values and their respective AGEs the last pavement surface feature was included in the table. For example, item 2, the Davenport Airport, indicates that the pavement has a seal coat which is two years old, that it was applied to a DBST surface and that the pavement surface currently has a PCI value of 82 percent.

TABLE 3-4D Surface maintenance techniques (PCI comparison).

NO.	AIRPORT NAME AND LOCATION	AGE (YEARS)	PCI (%)	SEAL SURFACE	LAST SURFACE
1	COLVILLE MUNICIPAL AP, WA	28	33	SC	DBST
2	DAVENPORT AP, WA	2	82	SC	BST
3	EPHRATA MUNICIPAL AP, WA	17	60	SS	3"AC
4	EPHRATA MUNICIPAL AP, WA	17	53	SS	2.5"AC
5	FERRY COUNTY AP, WA	8	65	SC	BST
6	HARVEY FIELD	6	64	SC	2"AC
7	KENNEWICK-VISTA FIELD, WA	11	69	SC	2"AC
8	LIND AP, WA	5	51	SS	SS
9	MANSFIELD AP, WA	5	35	SC	SC
10	PANGBORN FIELD-WENATCHEE AP, WA	14	63	SC	UN
11	PANGBORN FIELD-WENATCHEE AP, WA	14	66	SC	UN
12	PEARSON AIRPARK , WA	12	58	SC	1.5"AC
13	PEARSON AIRPARK , WA	12	84	SC	1.5"AC
14	PROSSER AP, WA	6	88	SC	2"AC
15	PRU FIELD RITZVILLE AP, WA	2	83	SC	TBST
16	QUINCY MUNICIPAL AP, WA	7	72	SS	BST
17	SANDERSON FIELD, SHELTON, WA	9	77	SS	2"AC
18	SEKIU AP, WA	1	86	SC	2"AC
19	SEKIU AP, WA	1	88	SC	2"AC
20	SUNNYSIDE MUNICIPAL AP, WA	2	85	SS	3"AC
21	WATERVILLE AP, WA	5	65	BST	BST
22	WHITMAN COUNTY MEMORIAL AP, WA	5	57	SS	BST
23	BAKER MUNICIPAL AP, OR	2	88	FS	2.5"AC
24	BAKER MUNICIPAL AP, OR	2	90	FS	2.5"AC
25	BANDON STATE AP, WA	14	72	SC	2.5"AC
26	BURNS MUNICIPAL AP, OR	12	50	SC	SC
27	BURNS MUNICIPAL AP, OR	12	49	SC	SC
28	CHILOQUIN STATE AP, WA	9	25	SC	1.25"AC
29	LAKE COUNTY AP, OR	2	71	SS	1.75"AC
30	MC MINNVILLE MUNICIPAL AP, OR	8	61	SS	2"AC
31	ROSEBURG MUNICIPAL AP, OR	1	77	SS	2"AC
32	SCAPPOOSE INDUSTRIAL AP, OR	1	65	SS	2"AC
33	NEWPORT MUNICIPAL AP, OR	4	69	SS	2"AC
34	THE DALLES MUNICIPAL AP, OR	23	79	SS	2.25"AC
35	TILLAMOK AP, OR	4	77	SC	2"AC
36	BURLEY MUNICIPAL AP, ID	6	67	SS	2.5"AC
37	CALDWELL AP, ID	2	94	SS	2"AC
38	CALDWELL AP, ID	2	100	SS	2"AC
39	COEUR D"ALENE AIR TERMINAL, ID	13	77	SS	3"AC
40	COEUR D"ALENE AIR TERMINAL, ID	13	79	SS	3"AC
41	COEUR D"ALENE AIR TERMINAL, ID	13	79	SS	3"AC

CONTINUED NEXT PAGE

TABLE 3-4D continued

NO.	AIRPORT NAME AND LOCATION	AGE (YEARS)	PCI (%)	SEAL SURFACE	LAST SURFACE
42	...COEUR D"ALENE AIR TERMINAL, ID	13	89	SS	3"AC
43	...CRAIGMOUNT MUNICIPAL AP, ID	3	57	SC	1"AC
44	...GOODING MUNICIPAL AP, ID	1	86	SS	2"AC
45	...JEROME COUNTY AP, ID	11	65	SC	7.5"AC
46	...KELLOGG AP, ID	3	40	SS	UN
47	...MC CALL MUNICIPAL AP, ID	1	87	SS	3"AC
48	...NAMPA MUNICIPAL AP, ID	1	91	SS	2"AC
49	...SODA SPRINGS AP, ID	3	42	SS	2.5"AC

3.3.5 PORTLAND CEMENT CONCRETE (PCC) There were only 10 pavements which had a PCC surface and all but one of them were constructed during World War II. Only one of the PCC pavements had a PCI value below 40 percent and none of them failed. Refer to Table 3-5 for the name and locations of the airports which had portland cement concrete runways.

TABLE 3-5 PORTLAND CEMENT CONCRETE PAVEMENT

NO.	AIRPORT NAME AND LOCATIONS	AGE (YEARS)	PCI (PERCENT)
1	...BOWERMAN FIELD, HOQUIAM, WASHINGTON	43	86
2	...BOWEMWAN FIELD, HOQUIAM, WASHINGTON	43	33
3	...CHEHALIS-CENTRALIA AIRPORT, WASHINGTON	43	84
4	...CHEHALIS-CENTRALIA AIRPORT, WASHINGTON	43	78
5	...EPHRATA MUNICIPAL AIRPORT, WASHINGTON	44	40
6	...EPHRATA MUNICIPAL AIRPORT, WASHINGTON	44	47
7	...WALLA WALLA CITY/COUNTY AP, WASHINGTON	45	58
8	...WALLA WALLA CITY/COUNTY AP, WASHINGTON	45	60
9	...CONDON STATE AIRPORT, OREGON	2	94
10	..MADRAS CITY/COUNTY AIRPORT, OREGON	43	46

3.4 DATA INTERPRETATION and THE PAVEMENT CONDITION RATING SCALE

Figure 6 is a representation of the pavement rating scale that the FAA uses to categorize and assign pavement condition ratings. The scale indicates that pavements which have a PCI rating below 55 percent are in fair condition and those with a rating of 40 percent and lower are in poor to very poor condition. Although the rating scale goes to zero it actually "fails" the pavement when it reaches a PCI value of 10 percent.

The pavement condition rating scale would be extremely useful if there were an established point where the airport pavement was considered to be unusable. A similar rating scale is used in evaluating surface distress in highway pavement called PCR [8,10]. A rule of thumb that is some times used by highway pavement experts is that highway, flexible pavements having a PCR value of 40 percent (or lower) are considered to be unacceptable and are in need of repair or rehabilitation. Although the highway PCR scale and airport PCI scale both rate pavements from 0 to 100 percent and appear to be identical, they are not. A cursory review of the methods used to rate the pavements on the two scales, indicates that a 40 percent pavement rating on the PCR is approximately equal to 55 percent rating on the PCI

scale. Note, that this is somewhat reinforced by the fact that very little of the airport pavement data has PCI values below 55 percent. The same rule of thumb will be used in determining when an airport pavement has reached a useful life and for estimating PCI loss per year. However, a PCI value of 55 percent rather than of 40 percent will be used as the minimum acceptable limit .

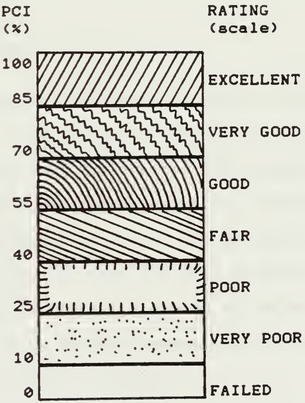


FIGURE 3-1 PAVEMENT CONDITION RATING SCALE

CHAPTER 4
ANALYSIS and RESULTS

****

4.1 ANALYSIS INTRODUCTION

The Washington State Department of Transportation (WSDOT) study, entitled "Regression Analysis for WSDOT Material Applications" [1], was used extensively and provided the framework used to generate the regression equations presented in this report.

4.2 REGRESSION MODELING

Although there was a considerable amount of pavement information, several of the categories had limited data points after the information was divided and grouped according to similar surface characteristics. Therefore, when using the regression models which are presented later in this chapter, it is essential that the user understand them to be only rough approximations. A strong recommendation is never use the equations to predict pavement performance outside than the oldest AGE data point.

4.2.1 SIMPLE REGRESSION ANALYSIS   Simple regression analysis was the key method used to evaluate the pavement data. Simple regression provides a straight line equation

that uses one variable to predict the variations in a second, and that comes the closest to minimizing the differences between a line and the different data points used in the regression. As previously stated, the regression analysis was accomplished with the computer software package MINITAB [2].

The generation of the regression equations from the available data is only a start. There are several conditions which must be met before the statistically generated equations can be used to make reasonable inferences regarding the data. To ensure the information being generated meets these conditions there are several tests which can be run. These "TESTS" are outlined in brief form and presented below:

(a) R-SQUARED R-squared is referred to as the coefficient of determination and used to "explain how much of the total variation in the data is explained by the regression line".[1] In short, when all the data points fall on the predicted line, the R-squared value equals 100 percent. Therefore, in this evaluation the larger the R-squared value, the better the information.

(b) T-RATIO The T-Ratio is the result of a hypotheses test which determines how well the independent variable predicts the dependent variable. In this analysis the PCI value is the dependent variable and AGE is the independent variable. As stated in reference 3 "The t-ratio should generally be greater than 2.0 for each independent variable to be a relatively strong predictor for the dependent variable".

(c) SEE The SEE value is the standard error of the estimate[3]. As stated in reference 3, "the SEE is used to estimate the standard deviation of the dependent variable about the regression line and is in units of the dependent variable. The smaller the SEE for a regression equation the better." In this study a value between five and ten was considered to be a reasonable value for the standard error of the estimate.

In conjunction with the regression equation, the MINITAB software package also provides the R-squared, T-ratio, and the SEE values.

4.2.2 REGRESSION ASSUMPTIONS The basic idea behind the regression modeling approach used in this paper is to take the respective PCI information and plot performance curves based on the pavement's present condition.

A major assumption used in the analysis was that the pavement's original PCI rating at the time of construction was 100 percent and the present PCI rating will be something less than 100 percent. To accommodate this assumption (that every pavement was originally constructed with a PCI equal to 100 percent) entering data points with values of PCI=100 and AGE=0 for each set of data points used to describe the pavement's current condition was required. For example, if there were ten data points (five sets of PCI and AGE values) taken from the surveyed information, then ten data points of PCI=100 and AGE=0 were added to the data for that particular

analysis. The assumption only applied to those pavements which were newly constructed, reconstructed, or overlaid. It was not applied to the various asphalt surface maintenance techniques, such as chip seals, slurry seals, fog seals,or seal coats, nor was it applied to thin AC overlays.

4.2.3 REGRESSION EQUATION DEVELOPMENT The use of the assumption that every pavement had an initial (AGE=0) PCI rating equal to 100 percent greatly increased the values used in determine the reasonableness of the regression equations. This assumption is probably not completely agreeable to everyone. Even though there is no firm data available to back this assumption it is very logical to assume that airport managers would not accept a new pavement or overlay which did not have a PCI rating close to 100 percent. In order to satisfy any skepticism regarding this assumption, a regression analysis was also run on the data without incorporating the additional data points. The results were basically the same. The differences were in the Y-intercept, T-ratio and R-squared values.

There is a similar procedure for measuring the observed pavement distress in Highway Pavement. It determines what is known as the Pavement Condition Rating (PCR) and is primarily used to measure the severity of surface cracking in the pavement. There has been some modeling done using this value

of PCR. It was found that the highway pavement data was best modeled when a logarithm transformation was done on the variables [1]. The original assumption was that airfield pavements would react in much the same manner. Therefore, the airfield pavement variables were also transformed using logarithms. The results of the logarithm transformation have been included in the tables for those pavements on which the calculation were done. The reason logarithm transformation was not performed on all the data was the results continually provided a lower quality model.

4.3 REGRESSION ANALYSIS AND RESULTS

The following sections provide the results of the analysis and a brief statement on the procedure used to determine the BEST REGRESSION EQUATIONS for each of the different pavement or surface treatments analyzed.

Unless stated otherwise, the regression equation presented in the tables were developed using all the available data points for that particular pavement feature.

The average PCI loss per year was calculated using the rule of thumb presented in chapter 3 (that the maintenance and repairs were performed on the pavement surface when it reached a PCI rating of 55 percent) and the previously stated assumption (that the pavement had a PCI rating of 100 percent immediately after construction).

To assist in clarifying how the information was grouped, a brief description of the various pavement characteristics will be provided prior to the analysis of each section.

There are two basic types of pavement, flexible and rigid. The pavement condition surveys made reference to several types and variations of flexible pavement, ranging from AC overlays to bituminous surface treatments. The surveys also indicated the use of several different surface applications used for maintenance purposes. The rigid pavements surveyed consisted of portland cement concrete. Because of these variations, the pavement data was arranged on the basis of how the pavement condition surveys distinguished and described the various pavement surfaces. The following outline shows how the pavement data was grouped for analysis and evaluation:

(a) FLEXIBLE PAVEMENT	4.3.1
(b) AC OVERLAYS	4.3.2
(c) BITUMINOUS SURFACE TREATMENTS	4.3.3
(d) SURFACE TREATMENT SEAL COATS	4.3.4
(e) RIGID PAVEMENT	4.3.5

4.3.1 FLEXIBLE PAVEMENTS The information on the flexible pavements was divided into several different categories and analyzed independently, based on the thickness

of the asphalt concrete (AC). The regression analysis was first performed on the data from each individual state and then on the combined data from all three states. The results are presented in the following tables in similar fashion, first by state (Washington, Oregon, and Idaho) and finally in their combined form.

TABLE 4-1A Regression equations for flexible pavements with two to three inches of AC on six to eight inches of base.

****

(with data points of AGE=0 and PCI=100)

WASHINGTON	OREGON
PCI = 99.1 - 1.59(AGE)	PCI = 98.8 - 0.848(AGE)
t-ratio = 11.46	t-ratio = 7.81
R-sq(adj) = 83.9%	R-sq(adj) = 65.9%
SEE = 5.61	SEE = 5.58
N = 26	N = 32
IDAHO	**COMBINED**
PCI = 99.4 - 1.16(AGE)	PCI = 98.8 - 1.12(AGE)
t-ratio = 12.86	t-ratio = 12.18
R-sq(adj) = 94.8	R-sq(adj) = 68.8
SEE = 1.75	SEE = 6.3
N = 10	N = 68

N = 68 sets of data from 30 airports

continued next page

****

TABLE 4-1A continued

(without data points of AGE=0 and PCI=100)

WASHINGTON
PCI = 94.4 - 1.30(AGE)
t-ratio = 3.74
R-sq(adj) = 51.9%
SEE = 7.92
N = 13

OREGON
PCI = 91.1 - 0.431(AGE)
t-ratio = 1.57
R-sq(adj) = 8.8%
SEE = 7.38
N = 16

IDAHO
PCI = 96.5 - 0.926(AGE)
t-ratio = 4.71
R-sq(adj) = 84.1%
SEE = 2.71
N = 5

COMBINED
PCI = 92.2 - 0.732(AGE)
t-ratio = 3.33
R-sq(adj) = 23.4%
SEE = 8.47
N = 34

N = 34 sets of data points from 30 airports

Equations from variable transformation using logarithms (without data points of AGE=0 and PCI=100).

WASHINGTON
PCI = 112.2(AGE)$^{-0.162}$
t-ratio = 3.09
R-sq(adj) = 41.69%
SEE = .05132
N = 13

OREGON
PCI = 95.5(AGE)$^{-0.0534}$
t-ratio = 1.65
R-sq(adj) = 10.4%
SEE = .03907
N = 16

IDAHO
PCI = 100.0(AGE)$^{-0.075}$
t-ratio = 5.44
R-sq(adj) = 87.7%
SEE = .009329
N = 5

COMBINED
PCI = 102.3(AGE)$^{-0.0887}$
t-ratio = 3.24
R-sq(adj) = 22.3%
SEE = .04832
N = 34

N = 34 sets of data points from 30 airports

TABLE 4-1B Regression equations for flexible pavements with two to three inches of AC on eight inches of base or thicker.

****

<u>(with data points of AGE=0 and PCI=100)</u>

WASHINGTON
PCI = 100.0 - 1.08(AGE)
t-ratio = 3.59
R-sq(adj) = 51.9%
SEE = 7.68
N = 12

OREGON
PCI = 99.1 - 1.37(AGE)
t-ratio = 9.17
R-sq(adj) = 76.9%
SEE = 4.6
N = 26

IDAHO
PCI = 97.4 - 2.73(AGE)
t-ratio = 6.18
R-sq(adj) = 71.2%
SEE = 8.68
N = 16

COMBINED
PCI = 98.0 - 1.48(AGE)
t-ratio = 8.11
R-sq(adj) = 54.1%
SEE = 8.37
N = 54

N = 54 sets of data points from 21 airports

<u>(without data points of AGE=0 and PCI=100)</u>

WASHINGTON
PCI = 103 - 1.26(AGE)
t-ratio = 1.26
R-sq(adj) = 10.6%
SEE = 12.0
N = 6

OREGON
PCI = 97.1 - 1.22(AGE)
t-ratio = 4.51
R-sq(adj) = 61.7%
SEE = 6.57
N = 13

IDAHO
PCI = 78.2 - 0.77(AGE)
t-ratio = 0.78
R-sq(adj) = 0.0%
SEE = 9.95
N = 8

COMBINED
PCI = 91.9 - 1.00(AGE)
t-ratio = 2.83
R-sq(adj) = 20.6%
SEE = 11.32
N = 27

N = 27 sets of data points from 21 airports

****

TABLE 4-1C Regression equations for flexible pavements with three inches of AC (or greater) on any base.

****

<u>(with data points of AGE=0 and PCI=100)</u>

PCI = 98.4 - 1.36(AGE)
t-ratio = 6.97
R-sq(adj) = 65.6%
SEE = 5.87
N = 26

N = 26 sets of data points from 11 airports

<u>(without data points of AGE=0 and PCI=100)</u>

PCI = 91.1 - 0.753(AGE)
t-ratio = 1.76
R-sq(adj) = 14.9
SEE = 7.565
N = 13

N = 13 sets of data points from 11 airports

****

Note: As stated in Chapter 3 , when the correlation calculations were being run on this particular pavement feature it was assumed that the thickness of the base had little to no effect on the pavements PCI rating or expected average life. Therefore all pavements with an AC thickness of three inches or larger were considered together.

As seen by the results presented in Tables 4-1A, 4-1B, and 4-C, when the flexible pavement data included the additional data points of (AGE=0 and PCI=100 percent) the

R-squared values and the t-ratios increased in all cases. Rather than plotting the same information for all the categories, the regression results were reviewed from several different aspects.

(a) Figure 4-1 shows the plotted regression equations when the additional data points of AGE=0 and PCI=100 percent are included in the analysis for two to three inches of AC on six to eight inches of base (Table 4-1A).

(b) Figure 4-2 plots the regression equations without the additional data points of AGE=0 and PCI=100 percent for two to three inches of AC on eight inches of base (or thicker) (Table 4-1B).

(c) Figure 4-3 is a comparison plot showing the regression equations with and without (AGE = 0 and PCI = 100) points for three inches of AC (or greater) on any base (Table 4-1C).

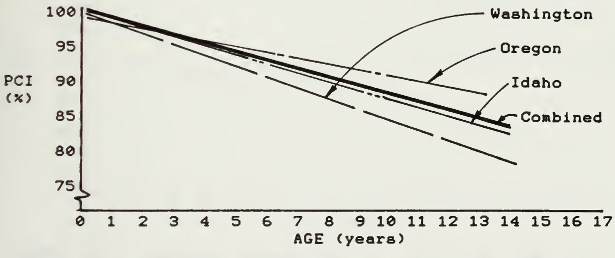


FIGURE 4-1 Flexible pavement PCI vs AGE curve. Comparing the pavement performance by state, when the additional data points were included.

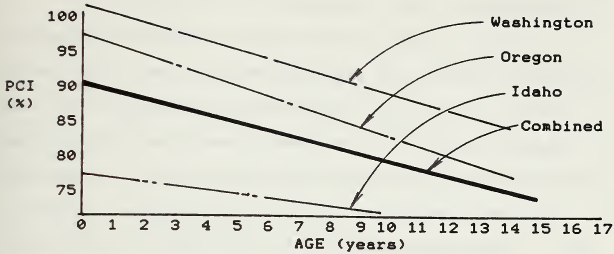


FIGURE 4-2 Flexible pavement PCI vs AGE curve. Comparing the pavement performance by state, when the additional data points were not included.

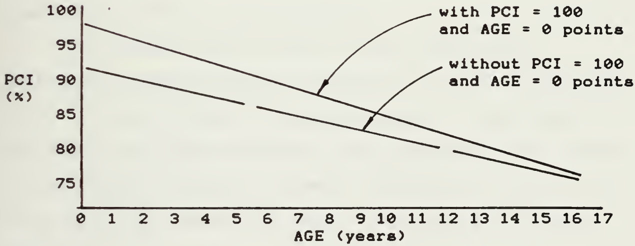


FIGURE 4-3 Flexible pavement PCI vs AGE curve. Comparing how the pavement performed with and without the additional data points.

The non-World War Two pavement life was estimated by taking the difference between the pavements original construction date and the date when the pavement received the first maintenance application. This does, however, assume that the pavement received a surface application because it was approaching a condition where it would be unusable. An estimated reduction in PCI per year was calculated by using the rule of thumb assumption. The runway information was divided and examined based on initial AC surface thicknesses Table 4-1D. Figure 4-4 shows how the different pavement thicknesses compare.

The pavement life characteristics of the World War Two pavements are provided in Table 4-1E. Table 3-1E is a list of those World War Two airports which were addressed independently. Note, all pavements were examined together regardless of their characteristics.

The average PCI loss per year for the various maintenance applications was included for general comparison only. If used, it must be understood that it was based on the assumption that the initial application had a PCI rating of 100 percent, which is somewhat supported by Tables 3-1A, 3-1B, 3-1C for flexible pavements and by Table 3-2 for AC overlays.

TABLE 4-1D Pavement life characteristics for non-World War Two flexible pavements (various AC thicknesses).

****

<u>(Half inch to one and one half inches)</u>

AVERAGE LIFE = 11.7 years
SHORTEST LIFE = 3.0 years
LONGEST LIFE = 19.0 years
AVG. PCI LOSS = 3.8 percent per year
STANDARD DEV. = 6.24
N = 7

<u>(Two inches to two and one half inches)</u>

AVERAGE LIFE = 13.0 years
SHORTEST LIFE = 4.0 years
LONGEST LIFE = 35.0 years
AVG. PCI LOSS = 3.5 percent per year
STANDARD DEV. = 8.88
N = 13

<u>(Three inches or more)</u>

AVERAGE LIFE = 14.0 years
SHORTEST LIFE = 10.0 years
LONGEST LIFE = 18.0 years
AVG. PCI LOSS = 3.2 percent per year
STANDARD DEV. = 3.78
N = 5

****

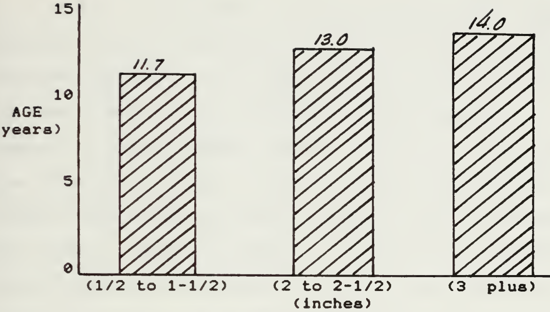


FIGURE 4-4 Flexible pavement (average age vs AC thickness).

TABLE 4-1E Pavement life characteristics for World War Two flexible pavements (one and one half to three inches of AC on six to eight inches of base).

****

AVERAGE LIFE	= 27.4 years
SHORTEST LIFE	= 9 years
LONGEST LIFE	= 43 years
AVG. PCI LOSS	= 1.6 percent per year
STANDARD DEV.	= 11.2
N	= 42

****

4.3.2 AC OVERLAYS (Tables 4-2A and 4-2B). Asphalt concrete overlays are used as a means of rehabilitating an existing pavement. They restore the existing pavement's surface characteristics and improve its structural integrity. The thickness of an AC overlay is determined by the intended use and can vary from one inch to several inches, with the most common thickness being approximately two inches. Table 3-2 lists the pavements and airports which were included in the overlay modeling. The overlays in this study ranged from one inch to ten inches, with two inches being the most common thickness. The AC overlays were analyzed as a single pavement feature based on their thicknesses (one inch, two inches, and three inches).

TABLE 4-2A Pavement life characteristics for AC overlays two inches to four inches.

AVERAGE LIFE =	11.6	years
SHORTEST LIFE =	8	years
LONGEST LIFE =	16	years
AVG. PCI LOSS =	3.9	percent per year
STANDARD DEV. =	2.63	
N =	7	

[illegible]

TABLE 4-2B Regression equations for flexible pavement overlays consisting of one to ten inches of AC.

****

<u>(with data points of AGE=0 and PCI=100)</u>

WASHINGTON	OREGON
PCI = 98.9 - 1.43(AGE)	PCI = 98.1 - 1.76(AGE)
t-ratio = 8.31	t-ratio = 7.55
R-sq(adj) = 66.0%	R-sq(adj) = 58.9%
SEE = 5.78	SEE = 6.6
N = 36	N = 40

IDAHO	COMBINED
PCI = 98.3 - 1.30(AGE)	PCI = 98.7 - 1.54(AGE)
t-ratio = 2.16	t-ratio = 11.11
R-sq(adj) = 25.0%	R-sq(adj) = 58.5%
SEE = 8.15	SEE = 6.4
N = 12	N = 88

N = 88 sets of data points from 33 airports

<u>(without data points of AGE=0 and PCI=100)</u>

WASHINGTON	OREGON
PCI = 92.8 - 0.88(AGE)	PCI = 93.8 - 1.21(AGE)
t-ratio = 2.09	t-ratio = 2.27
R-sq(adj) = 16.5%	R-sq(adj) = 18.0%
SEE = 7.88	SEE = 9.17
N = 18	N =20

IDAHO	COMBINED
PCI = 86.3 + 0.22(AGE)	PCI = 92.8 - 0.949(AGE)
t-ratio = 0.13	t-ratio = 3.00
R-sq(adj) = 0.0%	R-sq(adj) = 15.7%
SEE = 11.5	SEE = 8.63
N = 6	N = 44

N = 44 sets of data points from 33 airports

****

Note: When the additional data points were removed from the Idaho data, both the t-ratio and R-squared values fell below the limits considered necessary for reasonable inferences.

TABLE 4-2C Regression equations for flexible pavement AC overlays (one inch AC overlay).

****

<u>(with data points of AGE=0 and PCI=100)</u>

PCI = 97.7 - 1.29(AGE)
t-ratio = 2.36
R-sq(adj) = 33.7%
SEE = 5.473
N = 10

N = 10 sets of data points from 4 airports

<u>(without data points of AGE=0 and PCI=100)</u>

PCI = 89.2 + 0.005(AGE)
t-ratio = 0.0
R-sq(adj) = 0.0
SEE = 6.186
N = 5

N = 5 sets of data points from 4 airports

****

Note: The regression equation for the 1 inch AC overlay is not recommend for use. It is apparent that the additional data points greatly affected the regression equation.

TABLE 4-2D Regression equations for flexible pavement AC overlays (two inch AC overlay).

****

<u>(with data points of AGE=0 and PCI=100)</u>

PCI = 98.5 - 1.30(AGE)
t-ratio = 7.85
R-sq(adj) = 56.3%
SEE = 5.939
N = 25

N = 50 sets of data points from 21 airports

<u>(without data points of AGE=0 and PCI=100)</u>

PCI = 92.0 - 0.697(AGE)
t-ratio = 1.990
R-sq(adj) = 11.4
SEE = 7.777
N = 25

N = 25 sets of data points from 21 airports

****

TABLE 4-2E Regression equations for flexible pavement AC overlays (three inch AC overlay).

****

<u>(with data points of AGE=0 and PCI=100)</u>

PCI = 99.7 - 1.35(AGE)
t-ratio = 8.51
R-sq(adj) = 84.6%
SEE = 2.507
N = 14

N = 14 sets of data points from 6 airports

<u>(without data points of AGE=0 and PCI=100)</u>

PCI = 97.6 - 1.1(AGE)
t-ratio = 2.38
R-sq(adj) = 43.8%
SEE = 3.746
N = 7

N = 7 sets of data points from 6 airports

****

4.3.3 BITUMINOUS SURFACE TREATMENTS (BST) The bituminous surface treatments were analyzed based on the number of surface applications. When reviewing the results, it is important to remember the pavement condition surveys made no distinction between a BST used for maintenance and a BST which was the original surface course.

(a) <u>Single bituminous surface treatment (BST).</u> (Table 4-3A). All single BST applications were considered together. Table 3-3A lists the name and location of the airports used in estimating BST life.

When all the BST applications were considered the analysis indicates that BST surfaces have an average life of 9.2 years. However, the data used contained several pavements where the base and other pavement features were unknown (UNK). Therefore, the points containing the unknowns were removed and the average life was re-calculated. This dropped the average life of the BST by 2.2 years bringing it to 7.0 years. There was some question of how BSTs performed when they were applied a second time for maintenance purposes. The average life increased slightly to 8.8 years.

By using the rule of thumb, it can be hypothesized that BST pavements lose approximately five percent of their PCI rating per year.

(b) <u>Double bituminous surface treatments</u> (DBST) (Table 4-3B) As stated above the term DBST refers to a pavement that has received two applications of BST. It was anticipated that the DBST would perform slightly better than the BSTs, however, this was not the case. The average DBST life was approximately two years less than the average BST life. Refer to table 3-3B for the name and location of the airports which currently have DBST applications.

(c) <u>Current BST/DBST/TBST PCI</u> (Table 4-3C) There were several runway pavements whose most recent surface applications were bituminous surface treatment. In an attempt to draw a conclusion on how the various bituminous surface treatments compared to asphalt concrete surfaces, they were grouped together and analyzed as a single surface. The end result showed that the data had very little in common. The model which was generated (Table 4-3C) is not considered reliable for making inferences (R-squared almost zero and the t-ratio well below two).

Figure 4-5 provides a summary of how the various bituminous surface treatments and surface maintenance applications compare. The average maintenance BST or second BST application life was included in the figure to see how it compared to the average seal coat life.

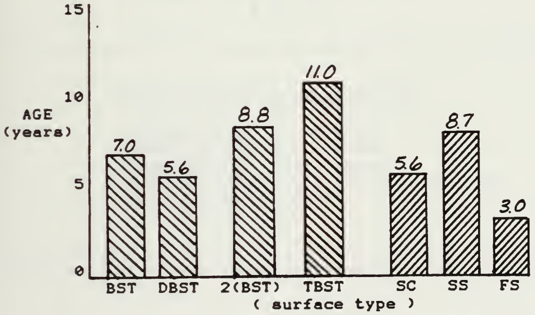


FIGURE 4-5 Bituminous surface treatments vs surface maintenance techniques.

TABLE 4-3A Pavement life characteristics for bituminous surface treatments.

****

(with all data points)

```
AVERAGE LIFE  = 9.2 years
SHORTEST LIFE = 1.0 years
LONGEST LIFE  = 29  years
AVG. PCI LOSS = 4.9 percent per year
STANDARD DEV. = 6.4
            N = 22
```

(minus data points with unknowns)

```
AVERAGE LIFE  = 7 years
SHORTEST LIFE = 1 year
LONGEST LIFE  = 14 years
AVG. PCI LOSS = 6.4 percent per year
STANDARD DEV. = 4.11
            N = 13
```

(BST maintenance application)

```
AVERAGE LIFE  = 8.8 years
SHORTEST LIFE = 6   years
LONGEST LIFE  = 18  years
AVG. PCI LOSS = 5.1 percent per year
STANDARD DEV. = 5.17
            N = 5
```

****

TABLE 4-3B Pavement life characteristics for double bituminous surface treatments.

****

```
AVERAGE LIFE   = 5.6 years
SHORTEST LIFE  = 2   years
LONGEST LIFE   = 13  years
AVE. PCI LOSS  = 8 percent per year
STANDARD DEV.  = 3.4
             N = 9
```

****

TABLE 4-3C Regression equations based on latest bituminous surface treatment (BST, DBST, and TBST).

****

```
PCI =  77.1 - 1.54(AGE)
t-ratio = 1.51
R-sq(adj) = 7.8
SEE = 15.71
N = 16
```

****

Note: The t-ratio, R-squared(adj), and SEE values all indicate that this equations should not be used.

4.3.4 SURFACE MAINTENANCE APPLICATIONS and TECHNIQUES

The various maintenance techniques are utilized to serve a variety of functions. The maintenance techniques, which include a layer of aggregate, appear to provide the best life. For a comparison of the various surface maintenance techniques against the bituminous surface treatments see Figure 4-5.

Chip seals and seal coats were combined in a single category called seal coats and the emulsion applications were combined with the fog seals.

The average PCI loss per year for the various maintenance applications was also included. The basic assumption that the initial application had a PCI rating of 100 percent is not supported for maintenance applications as it is for flexible pavements and overlays. In fact, Table 3-3C lists four runway pavements that are less than one year old and have PCI values of 56, 98,76, and 73.

As previously stated, BST applications used for maintenance measures and seal coats are really the same thing. This assumptions is supported by comparing the average life of the maintenance BST (8.8 years) and the average life of the seal coat (8.7 years). The average life of the fog seals was much shorter than the average life of the slurry seals and seal coats.

TABLE 4-4A Pavement life characteristics for Slurry Seals.

****

AVERAGE LIFE	= 5.6 years
SHORTEST LIFE	= 3.0 years
LONGEST LIFE	= 10.0 years
AVG. PCI LOSS	= 8 percent per year
STANDARD DEV.	= 2.99
N	= 6

****

TABLE 4-4B Pavement life characteristics for seal coats.

****

AVERAGE LIFE	= 8.7 years
SHORTEST LIFE	= 2.0 years
LONGEST LIFE	= 16.0 years
AVG. PCI LOSS	= 5.2 percent per year
STANDARD DEV.	= 4.30
N	= 9

****

TABLE 4-4C Pavement life characteristics for fog seals.

****

AVERAGE LIFE	= 3.0 years
SHORTEST LIFE	= 2.0 years
LONGEST LIFE	= 5.0 years
AVG. PCI LOSS	= 15 percent per year
STANDARD DEV.	= 1.23
N	= 5

****

Note: All the data on fog seals came from airports in Idaho. The FAA will not fund fog seal applications, which might explain their limited use.

TABLE 4-4D Regression equations for surface maintenance applications (seal coats and slurry seals).

****

<u>(slurry seals)</u>

PCI = 74.0 - 0.25(AGE)
t-ratio = 0.46
R-sq(adj) = 0
SEE = 16.11
N = 24

<u>(seal coats)</u>

PCI = 77.6 - 1.46(AGE)
t-ratio = 2.54
R-sq(adj) = 21.4
SEE = 16.25
N = 20

<u>(combination seal coats and slurry seals)</u>

PCI = 76.2 - 0.0919(AGE)
t-ratio = 2.39
R-sq(adj) = 9.1
SEE = 16.35
N = 48

****

Note: The PCI and AGE values from the various surface treatment seal coats were very inconsistent. A regression analysis was done on slurry seals and seal coats separately and then on a combined basis. The slurry seals did not provide a usable model.

4.3.5 PORTLAND CEMENT CONCRETE Rigid pavements consist of a portland cement concrete slab placed on a base course or in some cases just a well-prepared subgrade. There were only 10 pavements which had PCC surfaces, and all but one of them were constructed during World War II (WWII).

TABLE 4-5 Regression equations for portland cement concrete pavement.

****

(with data points of AGE=0 and PCI=100)

PCI = 99.7 - 0.931(AGE)
t-ratio = 6.95
R-sq(adj) = 71.3%
SEE = 12.97
N = 20

N = 20 sets of data points from 6 airports.

(without data points of AGE=0 and PCI=100)

PCI = 96.3 - 0.854(AGE)
t-ratio = 1.74
R-sq(adj) = 18.4
SEE = 19.42
N = 10

N = 10 sets of data points from 6 airports.

****

4.4 FINDINGS AND GENERAL OBSERVATIONS

4.4.1 AIRPORT RUNWAY PAVEMENTS APPEAR TO OUT-PERFORM HIGHWAY PAVEMENTS. The regression curves seem to indicate that airport pavements do not perform in the same manner as highway pavements. The same regression analysis on highway pavements indicates that pavement life is directly related to the number of ESAL's (traffic loading) [3 and 6]. By comparing regression equations generated from similar highway (PCR=98.5 - 3.1(AGE)) [3] and airport (PCI=98 - 1.48(AGE)) pavements one could conclude that airfield pavements out perform highway pavements; it is just not possible to determine to what extent. The highway equation indicates a PCR loss of approximately 3.1 percent per year, while the airport equation generated in this study indicates a PCI loss of only 1.48 percent per year. If this is true, the question is, why? Although the highway pavement condition rating (PCR) [10] and the FAA's pavement condition index (PCI) [4] appear to be the same, they are not. The two scales are similar enough to draw basic conclusions, as long as the equations are modeling similar pavements.

If one had to speculate why the airport pavements appear to out perform highway pavements, the conclusion most likely would be that airport pavements in general do not see the loads highway pavement do. This conclusion is somewhat

supported by the pavement condition survey data. For the most part, the pavement condition survey data did not include the actual survey sheets, as shown in Appendix B. However, the surveys did include a brief outline of the principal distresses found in the pavements. Although this distress information was not evaluated in this study, it was reviewed. The most typical condition of distress found during the surveys was cracking (longitudinal and traverse), and raveling. Very little distress appeared to be <u>load related</u>; this type of distress normally results in rutting and alligator cracking. The airports included in this study were predominately general aviation and most likely do not get heavy aircraft. This would support the theory that the distress variables appear to be non-load related. This also provides some explanation as to why the airport pavements lasted longer than highway pavements, whose performance is normally associated with loading. Figure 4-6 compares airport pavement performance (study) and some typical highway pavement performance[8] with several asphalt surface maintenance techniques.

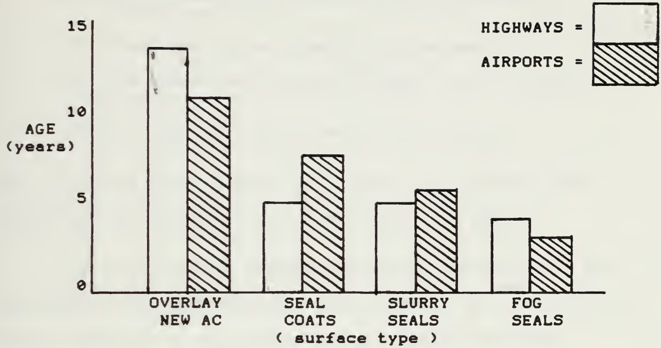


FIGURE 4-6 Asphalt surface maintenance techniques comparison (airport pavements vs highway pavements).

4.4.2 ON AN AVERAGE, WASHINGTON'S PAVEMENTS PERFORMED BETTER THAN OREGON'S OR IDAHO'S. This is substantiated by the regression equations found in Tables 4-1B and 4-2B. There are many possible explanations for this:

(a) Washington has better pavements.

(b) The individuals conducting the pavement condition surveys had different interpretation of how to rate a pavement's condition.

(c) The pavements were constructed with better materials.

(d) They used better construction methods.

(e) The environments were different for the various airports.

(f) The results were strictly coincidental.

Note, that the above explanations would hold true for any comparison made regarding the results of this study.

4.4.3 LOGARITHMIC TRANSFORMATIONS ON THE VARIABLES DID NOT PROVIDE THE BEST REGRESSION EQUATIONS. In an attempt to better approximate the plotted data, a logPCI vs logAGE regression was performed on the data from several of the pavement features. In most of the cases the log vs log regression resulted in lower R-squared and t-ratios values.

4.4.4 IT APPEARS THAT AIRPORT PAVEMENTS ARE MORE ENVIRONMENT DRIVEN THAN HIGHWAY PAVEMENTS. If this could be verified by some means, it may be worth looking at the data from various airports with similar climates. For instance, looking at table 3-3B, it can be seen that Moses Lake Municipal Airport had a average DBST life of 13 years and Colville Municipal Airport had an average DBST life of 9; the next closest average was 5 for Anacortes. The environment could very well be the airport pavement's worst enemy.

4.4.5 STRAIGHT LINE CURVES MAY NOT BE THE BEST FIT FOR THE DATA. In fact, the data would lead one to believe that airport pavements maintain a fairly even and slow deterioration over the first few years and then start a steady decrease downward. Figure 4-7 is a general approximation of a deterioration model curve based on the above observation.

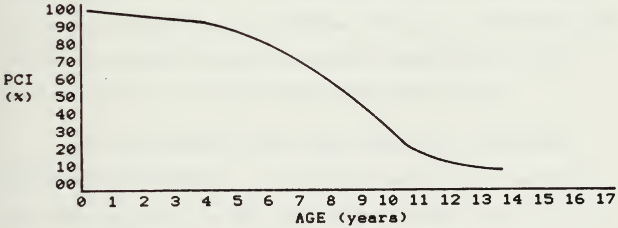


FIGURE 4-7 Flexible pavement curve based on observed data.

4.4.6 ASPHALT SURFACE MAINTENANCE APPLICATIONS DO NOT APPEAR TO ALTER THE PAVEMENTS PCI RATING. If they do, it is only for a few months. In fact, the data indicates that the PCI rating of pavements which have received some form of surface treatment was driven by the underlying pavement. This finding is reinforced by the regression analysis done on the various BST treatments found in Tables 4-3C and 4-4D. It strongly supports the theory that surface maintenance applications are not used to restore pavements to their original condition but rather to extend pavement life or postpone the need for a major rehabilitation project.

4.4.7 THE THICKNESSES OF THE AC OVERLAY DID NOT SEEM TO AFFECT THE PCI VALUES. There was no substantial increase in the PCI values from the thicker overlays, indicating that unless one needed the load carrying capabilities of the thicker overlay, it is not worth the extra money.

4.4.8 IT APPEARED THAT EACH STATE HAD A PREFERRED MAINTENANCE TECHNIQUE. Washington prefers to use BSTs, more appropriately called seal coats. Idaho used primarily Slurry Seals and was the only state to use fog seals. Although all three states used AC overlays, Oregon appeared to use them a higher percentage of the time. The data indicates that Oregon has less airports and used overlays in 31 instances compared to Washington's 25.

4.4.9 USING 55 PERCENT AS THE MINIMUM ACCEPTABLE PCI VALUE MAY NOT BE THE BEST WAY TO COMPARE THE PAVEMENTS. In order to perform the survival statistic calculations and provide a means of comparing the pavements, it was necessary to establish a PCI value where the airport pavements were considered unusable. Based on several reasons (the pavement condition rating scale and the highway pavement analysis rule of thumb) a PCI value of 55 percent was used (section 3.4). The resulting regression equations do not completely support the 55 percent value. For example, by inserting the 55 percent PCI value into the combined state regression equation (with data points of AGE=0 and PCI=100) found in table 4-1B, the estimated age of the pavement before requiring maintenance is 30 years. The FAA recommends a PCI value of 70 percent when considering an airport pavement to be unusable and requiring maintenance. By using 70 percent in the above equation the pavement would have lasted approximately 19 years. Nineteen years would appear to be a more reasonable life than 30 years when estimating pavement life. Although not totally supported by the data (since many of the pavements have PCI values below 70 percent) it might have been more appropriate to use a value of 70 percent.

CHAPTER 5
SUMMARY, RECOMMENDATIONS, and CONCLUSION

****

5.1 SUMMARY

The regression equations were generated using selected data; it is difficult to speculate how well they will model airport pavements in other areas of the United States. However, they should assist the FAA and respective airport administrators in determining which northwestern airports have pavements in greatest need of maintenance or rehabilitation. It is hoped that the models and survival statistics can be used by the various airport owners to evaluate their maintenance programs, assist with funding decisions, and provide the start for a data base.

Although an abundance of information has resulted from reviewing the pavement condition survey data, the final conclusion must be that, more information is needed. If these same pavements were surveyed again in two or three years the ensuing information would be invaluable. In addition to strengthening the models, the additional information would provide an excellent means of checking their validity. The FAA is currently doing follow-up pavement condition surveys.

The performance models provide an approximation of how the various airport pavements and maintenance techniques performed. However, they fall short in some areas, as would be expected, when examining data of this nature. Although the models may not directly assist in making those critical decisions, they will at least provide a means of limiting the alternatives. In addition to this, the models will provide the airport planner and engineer with an excellent guide for using future FAA pavement condition survey information and provide the FAA with a rational basis in for funding future airport projects.

5.2 RECOMMENDATIONS

The next step in studying the available information would be to draw some type of correlation between a particular type of distress and rate of deterioration. This information would greatly assist airport managers in determining what kind of corrective action best fits the type of distress their pavement is experiencing.

This study should only be the start. There is a considerable amount of information available in the pavement condition survey data and a follow-up report including taxiways and aprons is strongly suggested. The performance curves were based on data collected over the last three years. Also, if the information could be fed into a

centralized computer data bank, it could be shared throughout the United States, which in turn would increase the data usage.

The biggest problem area of the study was interpreting the data. The FAA currently has a requirement that all inspectors be trained by them prior to conducting the pavement condition surveys. This training includes information on common terminology and reporting requirements. However, there were still inconsistencies in the data terminology; terms were interchanged and misused. The best example of this problem is the use of the term BST; even though it is apparent that the FAA uses the terms BST and seal coat interchangeably this practice still leads to some confusion. This problem needs to be addressed and solved, in order to get the most out of future pavement conditions surveys. The FAA needs to establish a consistent set of terms for future pavement condition surveys and it is suggested that these terms be in agreement with those used in the highway industry.

Finally, when conducting future pavement condition surveys it is strongly recommended that the reason for the maintenance, rehabilitation, or new construction be included in the pavement history. This is essential if reasonable conclusions are to be made regarding the pavement surface's LIFE. In this study the lack of this valuable information

forced the assumption that all new surface applications (no matter what the type) were needed because the old surface had reached an unusable stage. No (statistical) consideration was given to the fact that the new surface could have been a preventative maintenance measure (e.g. several useful years still left on the pavement) or an airport mission change (e.g. larger loading requirements due to larger aircraft requiring thicker pavement).

5.3 CONCLUSION

The regression equations (models) and survival statistics derived from the available data provide rough approximations of how the various pavements perform. With an understanding of how the pavement condition survey data was used and how the various assumptions were applied, the airport manager will have one more decision making tool.

The original surveys showed a considerable amount of airport pavements in need of reconstruction or of some type of maintenance, repair, or rehabilitation. Therefore, there are several airport managers and their engineers who need to take immediate corrective action. For those who can not, the life-cycle performance regression models (equations) generated in this paper will at least provide them with an initial rough estimate of how long it will take before the pavement is unusable.

Forecasting how the system will change over time is a challenge, but the difficulty for the airport manger is in compiling a good data base. The uncertainty about the future reinforces the need for planning and for a continuous monitoring system.

As in most well-coordinated and well-operated facilities, one finds an engineering staff that is keyed to planning. A professionally operated and run airport is no different. It requires a management staff that is willing to put an effort into planning decisions. If the pavement condition surveys continue to be high on the priority list of both the FAA and airport management, they will provide an excellent means for anticipating future needs, evaluating rehabilitation projects, and monitoring in-use maintenance programs.

REFERENCES

1. Mahoney, J.P., "Regression Analysis for WSDOT Material Applications," Research Report WA-RD 143.2, Washington State Department of Transportation, Olympia, Washington November 1987.

2. Ryan, B.F., Joiner, B.L., and Ryan, T.A., Minitab Handbook Second Addition, PWS Publishers, Boston, Massachusetts, 1985.

3. Mahoney, J.P., "Pavement Performance Equations" Research Report WA-RD 143.1, Washington State Department of Transportation, Olympia, Washington, March 1988.

4. "Guidelines and Procedures for Maintenance of Airport Pavements", Advisory Circular 150/5380-6, U.S. Department of Transportation, Federal Aviation Administration, December 1982.

5. Mahoney, J.P., "CETS 543 Airport Engineering", Lecture Notes University of Washington, Department of Civil Engineering, Spring of 1988.

6. "Pavement Maintenance and Rehabilitation Techniques Using Asphalt", Institute of Transportation Studies, University of California, Berkeley, California, 1984

7. Merritt F.S. "Standard Handbook for Civil Engineers", Third Edition, published by the Mc Graw-Hill Book Company, 1983

8. Mahoney, J.P., "CETS 424 Pavement Design", Lecture Notes University of Washington, Department of Civil Engineering, Winter 1988.

9. Ashford N. and Wright P.H., "Airport Engineering ", Published by John Wiley and Sons, New York, 1979.

10. Nelson T.L. and LeClerc R.V.,"Development and Implementation Of Washington State's Pavement Management System", Report WA-RD 50.3, Washington State Department of Transportation, Olympia, Washington, February 1983.

ABBREVIATION
LEGEND
****
****

AC = ASPHALT CONCRETE

B = BASE

BS = BITUMINOUS SURFACE

BSB = BITUMINOUS STABILIZED BASE

BST = BITUMINOUS SURFACE TREATMENT

CS = CHIP SEAL

CB = CINDER BASE

DBST = DOUBLE BITUMINOUS SURFACE TREATMENT

E = EMULSION (surface treatment seal coat)

FS = FOG SEAL or FOG COAT

NWF = NON-WOVEN FABRIC

OL = OVERLAY

PFC = POROUS FRICTION COURSE

PRG = PIT RUN GRAVEL

PRB = PIT RUN BASE

PRSB = PIT RUN SUBBASE

SAND S = SAND SEAL

SB = SUBBASE

SC = SEAL COAT

SS = SLURRY SEAL

TBST = TRIPLE BITUMINOUS SURFACE TREATMENT

APPENDIX A

****

****

U.S. DEPARTMENT OF TRANSPORTAITION

FEDERAL AVIATION ADMINISTRATION

ADVISORY CIRCULAR

AC: 150/5380-6

DATE: 12/3/1982

****

GUIDELINES AND PROCEDURES

FOR

MAINTENANCE OF AIRPORT PAVEMENTS

****

U.S. Department of Transportation
Federal Aviation Administration

Guidelines and Procedures for Maintenance of Airport Pavements

AC: 150/5380-6
Date: 12/3/82

Advisory Circular

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

46

U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: GUIDELINES AND PROCEDURES FOR MAINTENANCE OF AIRPORT PAVEMENTS

Date: 12/3/82
Initiated by: AAS-200

AC No: 150/5380-6
Change:

1. PURPOSE. This advisory circular (AC) provides guidelines and procedures for maintenance of rigid and flexible airport pavements.

2. FOCUS.

a. Poor maintenance of airport pavements is the result of a variety of causes, among which are lack of funds, untrained personnel, and lack of adequate information. This AC provides specific guidelines and procedures for maintaining airport pavements and establishing an effective maintenance program. Specific types of distress, their probable causes, inspection guidelines, and recommended methods of repair are discussed.

b. This information has been developed to assist airport managers, engineers, and maintenance personnel responsible for pavement design, performance, maintenance and repair. It is intended primarily for use at small- and medium-size airports that may lack the technical support of an adequate well-trained engineering/maintenance staff or the financial resources to retain a pavement consultant.

3. RELATED READING MATERIAL. The publications listed in Appendix C, Bibliography, provide further guidance and technical information.

Leonard E. Mudd
LEONARD E. MUDD
Director, Office of Airport Standards

CONTENTS

Chapter 1. INTRODUCTION

CONTENTS (continued)

APPENDIX A: CONDITION SURVEY PROCEDURE

GENERAL

This appendix gives the detailed procedure for performing a pavement condition survey at civil airports. The procedure is presently limited to flexible pavements (all pavements with conventional bituminous concrete surfaces) and jointed rigid pavements (jointed nonreinforced concrete pavements with joint spacing not exceeding 25 ft). Specific objectives for the condition survey are:

- a. To determine present condition of the pavement in terms of apparent structural integrity and operational surface condition.
- b. To provide FAA with a common index for comparing the condition and performance of pavements at all airports and also provide a rational basis for justification of pavement rehabilitation projects.
- c. To provide feedback on pavement performance for validation and improvement of current pavement design, evaluation, and maintenance procedures.

The airport pavement condition survey and the determination of the PCI are the primary means of obtaining and recording vital airport pavement performance data. The condition survey for both rigid and flexible pavement facilities consists principally of a visual inspection of the pavement surfaces for signs of pavement distress resulting from the influence of aircraft traffic and environment.

BASIC AIRPORT INFORMATION

A considerable amount of basic airport data is incorporated into the condition survey report. Most of this information is contained in construction and maintenance records and in previous condition survey reports. To facilitate report preparation, the basic data should be accumulated and maintained by the airport engineer. The following items should be compiled for subsequent use during the condition survey:

- a. Design/construction/maintenance history. The history of maintenance, repair, and reconstruction from original construction of the airport pavement system to the present should be maintained. These data should reflect airport paving projects

and airport change projects accomplished either in-house or by a contractor.

b. Traffic history. Air carrier, commuter, cargo, and military aircraft traffic records, including aircraft type, typical gross loads, and frequency of operation.

c. Climatological data. Annual temperature ranges and precipitation data should be obtained from the weather office nearest the airport.

d. Airport layout. Plans and cross sections of all major airport components, including subsurface drainage systems. These should be updated to reflect new construction upon completion of the project.

e. Frost action. If applicable, records of pavement behavior during freezing periods and subsequent thaws should be recorded.

f. Photographs. Photographs depicting both general and specific airport conditions should be taken.

g. Pavement condition survey reports. All previous pavement condition survey reports should be maintained to be referenced in the current report.

A series of data summary sheets has been devised and is presented in Figures A-1 through A-4. These summary sheets should be helpful to the personnel involved in obtaining and maintaining the necessary information. Narrative information pertaining to unusual problems, solutions, or attempted solutions to these problems should be included. This information would be beneficial in determining research needs as well as in providing a means of distributing information.

OUTLINE OF BASIC CONDITION RATING PROCEDURE

The steps for performing the condition survey and determining the PCI are described below and in Figure A-5:

a. Station or mark off the airport pavements in 100-ft increments. This is done semipermanently to assure ease of proper positioning for the condition survey. The overall airport pavements must first be divided into features based on the pavements design, construction history, and traffic area. A designated pavement feature, therefore, has consistent structural thickness and materials, was constructed at the same time, and is located in one airport facility, i.e., runway, taxiway, etc. After initially designating the features on the airport, make a preliminary survey. This survey shall entail a brief but complete visual survey of all the airport pavements. By

observing distress in an individual feature, it may be determined whether there are varying degrees of distress in different areas. In such cases, the feature should be subdivided into two or more features.

b. The pavement feature is divided into sample units. A sample unit for jointed rigid pavement is approximately 20 slabs; a sample unit for flexible pavement is an area of approximately 5000 sq ft.

c. The sample units are inspected, and distress types and their severity levels and densities are recorded. Appendix B provides a comprehensive guide for identification of the different distress types and their severity levels. The criteria in Appendix B must be used in identifying and recording the distress types and severity levels in order to obtain an accurate PCI.

d. For each distress type, density, and severity level within a sample unit, a deduct value is determined from the appropriate curve.

e. The total deduct value (TDV) for each sample unit is determined by adding all deduct values for each distress condition observed.

f. A corrected deduct value (CDV) is determined using procedures in the appropriate section for jointed rigid or flexible pavements.

g. The PCI for each sample unit inspected is calculated as follows:

$$\text{PCI} = 100 - \text{CDV}$$

If the CDV for a sample unit is less than the highest individual distress deduct value, the highest value should be used in lieu of the CDV in the above equation.

h. The PCI of the entire feature is the average of the PCI's from all sample units inspected.

i. The feature's pavement condition rating is determined from a figure that presents verbal descriptions of a pavement condition as a function of PCI value.

SAMPLING TECHNIQUES

Inspection of an entire feature may require considerable effort, especially if the feature is very large. This may be particularly true for flexible pavements containing much distress. Because of the time and effort involved, frequent surveys of the entire feature may be

beyond available manpower, funds, and time. A sampling plan has, therefore, been developed so that an adequate estimate of the PCI can be determined by inspecting a portion of the sample units within a feature. Use of the statistical sampling plan described here will considerably reduce the time required to inspect a feature without significant loss of accuracy. However, this statistical sampling plan is optional, and inspection of the entire feature may be desirable. The airport engineer should specify whether statistical sampling may be used. The condition survey proceeds as follows:

a. Determination of pavement feature. The first step in the condition survey is the designation of pavement features. Each facility such as a runway, taxiway, etc., is divided into segments or features that are definable in terms of (1) the same design, (2) the same construction history, (3) the same traffic area, and (4) generally the same overall condition. General features can be determined from pavement design and construction records and can be further subdivided as deemed necessary based on a preliminary survey. It is important that all pavement in a given feature be such that it can be considered uniform. As an example, the center part of some runways in the traffic lanes should be separate features from the shoulder portion outside the traffic lanes.

b. Selection of sample units to be inspected. The minimum number of sample units that must be surveyed to obtain an adequate estimate of the PCI of a feature is selected from Figure A-6. Once the number of sample units η has been determined from Figure A-6, the spacing interval of the units is computed from

$$i = \frac{N}{\eta}$$

where

i = spacing interval of units to be sampled
N = total number of sample units in the feature
η = number of sample units to be inspected

All the sample numbers within a feature are numbered and those that are multiples of the interval i are selected for inspection. The first sample unit to be inspected should be selected at random between 1 and i. Sample unit size should be 5000 sq ft (generally 50 by 100 ft) for flexible pavement and 20 adjacent slabs for rigid pavement. Figures A-7 and A-8 illustrate the division of a jointed rigid pavement and flexible pavement feature, respectively, into sample units.

Each sample unit is numbered so it can be relocated for future inspections, maintenance needs, or statistical sample purposes. Each of the selected sample units must be inspected and its PCI determined. The mean PCI of a pavement feature is determined by averaging the PCI of each sample unit inspected within the feature. When it is desirable to inspect a sample unit that is in addition to those selected by the above procedure, then one or more additional sample units may be inspected and the mean PCI of the feature computed from:

$$PCI_f = \frac{(N - A)}{N} \overline{PCI_1} + \frac{A}{N} \overline{PCI_2}$$

where

PCI_f = mean PCI of feature

N = total number of sample units in feature

A = number of additional sample units

$\overline{PCI_1}$ = mean of PCI for n number of statistically selected units

$\overline{PCI_2}$ = mean PCI for all additional sample units

It is necessary that each sample unit be identified adequately so that it can be relocated for additional inspections to verify distress data or for comparison with future inspections. Based on significant variation of sample unit PCI along a feature and/or significant variation in distress types among sample units, one feature should be divided into two or more features for future inspections and maintenance purposes.

DETAIL SURVEY PROCEDURE FOR RIGID PAVEMENT

Each sample unit, or those selected by the statistical sampling procedure, in the feature is inspected. The actual inspection is performed by walking over each slab of the sample unit being surveyed and recording distress existing in the slab on the jointed rigid pavement survey data sheet (Figure A-9). One data sheet is used for each sample unit. A sketch is made of the sample unit, using the dots as joint intersections. The appropriate number code for each distress found in the slab is placed in the square representing the slab. The letters L (low), M (medium), or H (high) are included along with the distress number code to indicate the severity level of the distress. For example, 15L indicates that low severity corner spalling exists in the slab.

Refer to Appendix B for aid in identification of distresses and their severity levels. Follow these guidelines very closely.

Space is provided on the jointed rigid pavement survey data sheet for summarizing the distresses and computing the PCI for the sample unit. Summarize the distress type numbers and their severity levels and the number of slabs in the sample unit containing each type and level. Calculate the percentage of the total number of slabs in the sample unit containing each distress type and severity level. Using Figures A-10 through A-24, determine the deduct value for each distress type and severity level. Sum the deduct values to obtain the deduct total.

Noting how many individual deduct values are greater than 5, consult Figure A-25 to obtain the CDV. The PCI is then calculated and the rating (from Figure A-26) is entered on the jointed rigid pavement survey data sheet (Figure A-9). If the CDV for a sample unit is less than the highest individual distress deduct value, the highest value should be used in determining the PCI.

The PCI's for all sample units are compiled into a feature summary, as shown in Figure A-27. The overall condition rating of the feature is determined by using the mean PCI and Figure A-26.

DETAILED PROCEDURE FOR FLEXIBLE PAVEMENT

Each sample unit, or those selected by the sampling procedure, in the feature is inspected. The distress inspection is conducted by walking over the sample unit, measuring the distress type and severity according to Appendix B, and recording the data on the flexible pavement survey data sheet (Figure A-28). One data sheet is used for each sample unit. A hand odometer is very helpful for measuring distress. A 10-ft straightedge and a 12-in. scale must be available for measuring the depths of ruts or depressions. Each column on the data sheet is used to represent a distress type, and the amount and severity of each distress located are listed in the column. For example, distress No. 5 (depression) is recorded as 6 × 4L, which indicates that the depression is 6 by 4 ft and of low severity. Distress type No. 8 (longitudinal and

transverse cracking) is measured in linear feet, thus 10L indicates 10 ft of light cracking. This format is very convenient for recording data in the field.

Each distress type and severity level are summed either in square feet or linear feet, depending on the type of distress. The total units, either in square feet or linear feet, for each distress type and severity level are divided by the area of the sample unit to obtain the percent density. Using Figures A-29 through A-44, determine the deduct value for each distress type and severity level. Sum the deduct values to obtain the deduct total.

Noting how many individual deduct values are greater than 5, use Figure A-45 to obtain the CDV. The PCI is then calculated, and the rating (from Figure A-26) is entered on the flexible pavement survey data sheet. If the CDV for a sample unit is less than the highest individual distress deduct value, the highest value should be used in determining the PCI.

The PCI's for each sample unit are compiled into a feature summary, as shown in Figure A-46. The mean PCI for the feature is determined by averaging the PCI's from each sample unit. The overall condition rating of the feature is determined by use of the mean PCI and Figure A-26.

REPORTING CONDITION SURVEY RESULTS

The format for reporting the findings of the airport condition survey may be informal, designed to preclude the necessity of extensive drafting and typing. The pavement distress data and PCI computations can be presented as directly obtained from the survey data sheets and computations. The basic airport data collected will primarily reflect changes in airport pavement systems that have occurred since the last condition survey report. Reports should be prepared by the airport engineer on a recurring cycle at intervals designed to reflect gradual changes in pavement surface conditions. Reports should include, but not be limited to, the following:

<u>a</u>. <u>Design pavement structure data</u>. A form, such as Figure A-1, to include the history of all airport pavements, from original construction to the most recent changes and additions.

b. Pavement structural evaluation summary. If available, a summary of the last structural evaluation data (see Figure A-2).

c. Pavement maintenance record. When, where, and what type of maintenance has been performed (see Figure A-3).

d. Aircraft traffic data survey. Types of aircraft, typical gross loads, and airport facilities most likely used by the aircraft; also, the frequency of operations (see Figure A-4).

e. Plans and cross sections.

 (1) Airport layout plan. The airport layout plan should depict airport pavements existing at the time of the condition survey. All airport facilities should be delineated and identified.

 (2) Condition rating. An airport layout plan keyed to indicate the narrative condition rating of each feature. The feature PCI's should be indicated, possibly in tabular form.

 (3) Drainage. Existing problem areas should be identified. Surface and subsurface drainage should be shown in plan and profile for all areas near to and intersecting with airport pavements.

f. Narrative. A narrative consisting of a written account of the visual condition of each feature. The purposes of the narrative are:

 (1) To briefly describe the general condition of the pavement facilities.

 (2) To describe operational conditions and problems.

 (3) To describe the condition of other airport facilities found near the load-bearing pavements such as runway shoulders and overrun areas.

g. Photographs. Photographs showing typical or specific pavement conditions. An aerial photograph, current within 3 years, is desirable.

____________ AIRPORT

DESIGN PAVEMENT STRUCTURE DATA REVISED: __________

FACILITY: ____________ LOCATION, OR SECTION DESIGNATION FROM LAYOUT: ____________

CONSTRUCTION DATE	DESIGNED BY	PAVEMENT SURFACE	BASE	SUBBASE	SUBGRADE
		TYPE/THICKNESS/STRENGTH	TYPE/THICKNESS/STRENGTH	TYPE/THICKNESS/STRENGTH	TYPE/STRENGTH

Figure A-1. Design pavement structure data

479

________________ AIRPORT

PAVEMENT STRUCTURAL EVALUATION SUMMARY

FACILITY	LOCATION	DATE OF EVALUATION	TYPE OF EVALUATION	EVALUATED BY	ALLOWABLE LOAD (AIRCRAFT, LOAD, DEPARTURES)	THICKNESS AND TYPE OF OVERLAY RECOMMENDED

Figure A-2. Pavement structural evaluation summary

_______________ AIRPORT

CHRONOLOGICAL PAVEMENT MAINTENANCE RECORD

FACILITY	LOCATION	DATE PERFORMED	PERFORMED BY	TYPE MAINTENANCE	REASON FOR MAINTENANCE

Figure A-3. Pavement maintenance record

48

__________ AIRPORT

TRAFFIC DATA SURVEY REVISED: ______

TYPE OF OPERATION	AIRCRAFT OPERATOR	TYPE AIRCRAFT	FACILITY MOST FREQUENTLY USED			TYPICAL GROSS WEIGHT	DEPARTURES PER DAY
			RUNWAY	TAXIWAY	APRON		
AIR CARRIER							
COMMUTER							
CARGO							
MILITARY							

Figure A-4. Traffic data survey

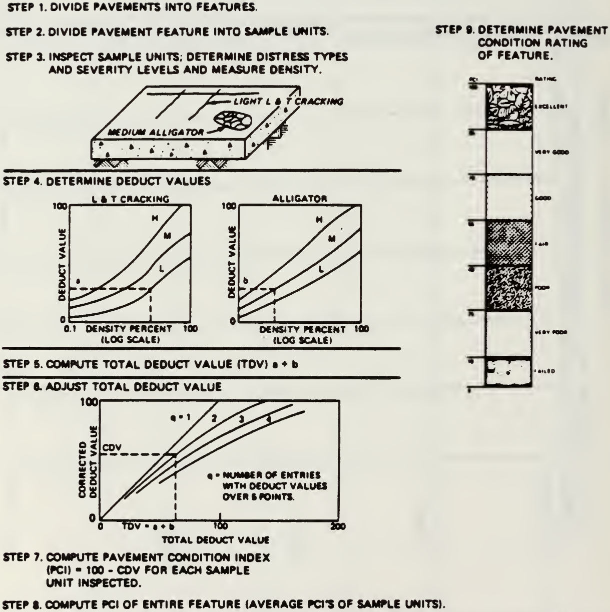


Figure A-5. Steps for determining PCI of a pavement feature

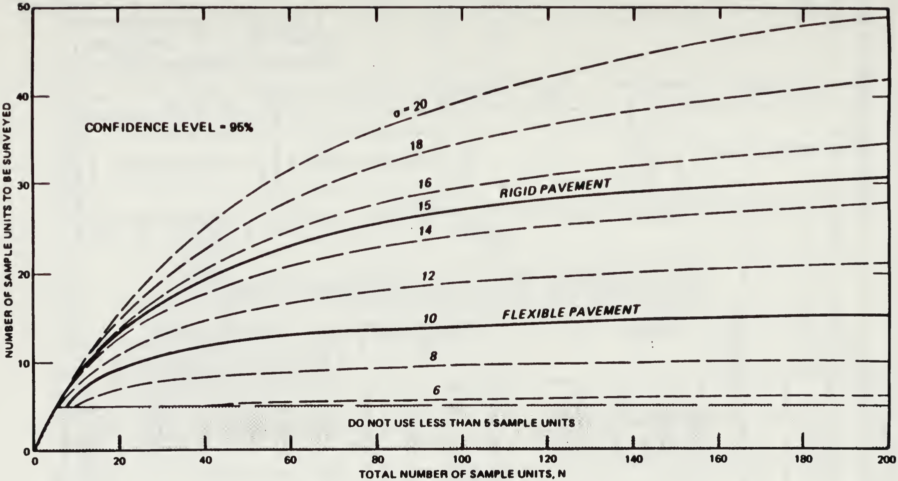


Figure A-6. Selection of minimum number of sample units

483

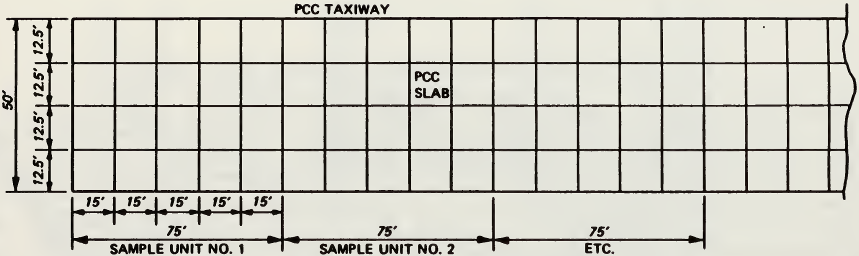


Figure A-7. Illustration of division of a jointed rigid pavement feature into sample units of 20 slabs

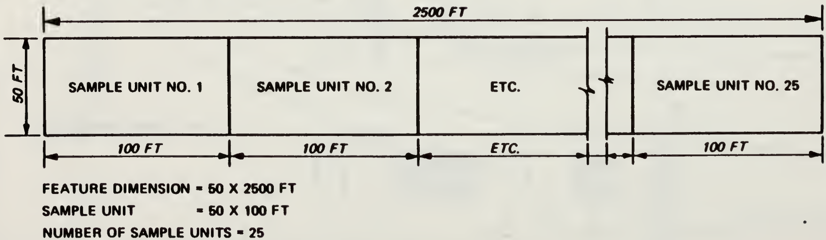
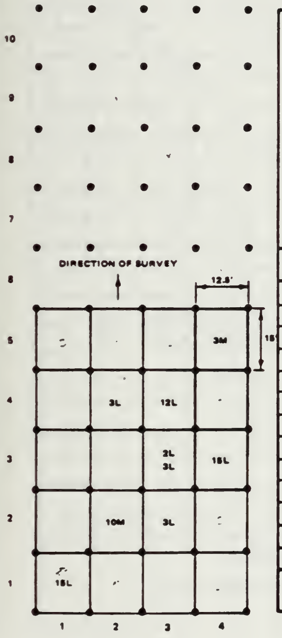


Figure A-8. Example division of flexible pavement feature into sample units

JOINTED RIGID PAVEMENT
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT WORLD INTERNATIONAL	DATE 5/25/79

FACILITY RWY 9-27	FEATURE R3	SAMPLE UNIT 12
SURVEYED BY JH/DE		SLAB SIZE 12.5 X 15 FT



DISTRESS TYPES

1. BLOW-UP
2. CORNER BREAK
3. LONGITUDINAL/ TRANSVERSE/ DIAGONAL CRACK
4. "D" CRACK
5. JOINT SEAL DAMAGE
6. PATCHING, <5 FT²
7. PATCHING/ UTILITY CUT
8. POPOUTS
9. PUMPING
10. SCALING/MAP CRACK/CRAZING
11. SETTLEMENT/ FAULT
12. SHATTERED SLAB
13. SHRINKAGE CRACK
14. SPALLING — JOINTS
15. SPALLING — CORNER

DIST. TYPE	SEV.	NO. SLABS	DENSITY %	DEDUCT VALUE
2	L	1	5	4
3	L	3	15	11
3	M	1	5	11
10	M	1	5	7
12	L	1	5	10
15	L	2	10	3
DEDUCT TOTAL				46
CORRECTED DEDUCT VALUE (CDV)				32

PCI = 100 – CDV = 68

RATING = GOOD

Figure A-9. Jointed rigid pavements - condition survey data sheet

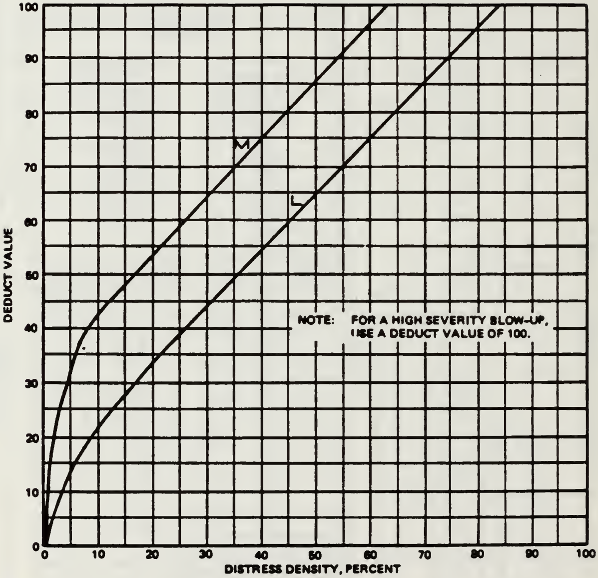


Figure A-10. Rigid pavement deduct values, distress 1, blowup

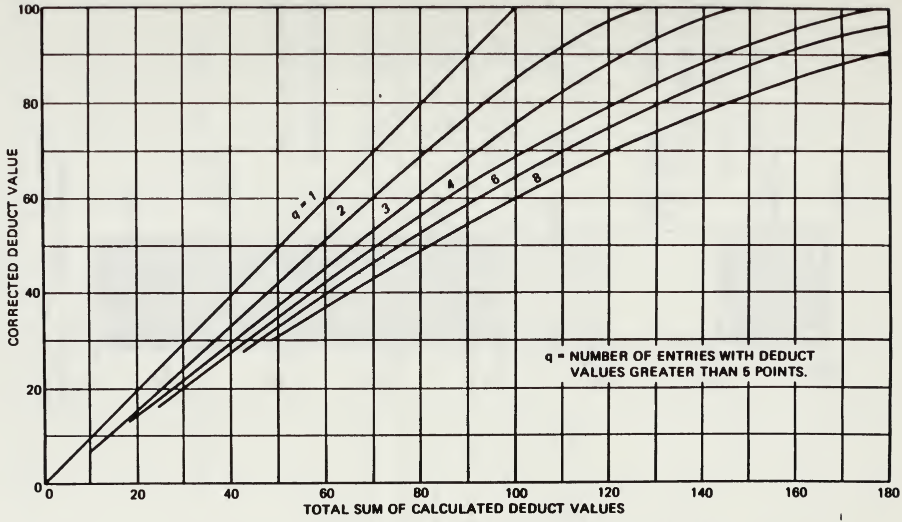


Figure A-25. Corrected deduct values for jointed rigid pavements

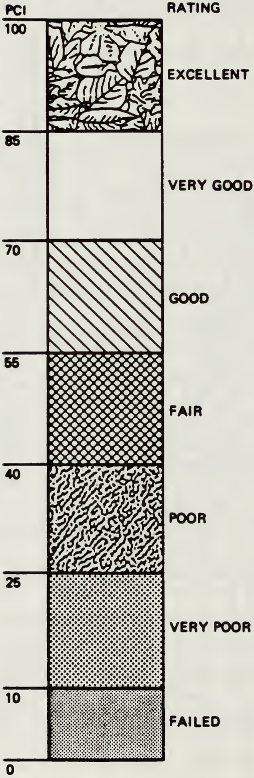


Figure A-26. Airport pavement condition index (PCI) and rating

503

Airport: World International

Airport Facility: Taxiway 1

Total No. of Sample Units: 5

Date of Survey: 15 March 1979

Sample Unit No.	No. of Slabs	Slab Size	PCI
1	20	12.5 x 15	68
2	20	12.5 x 15	64
3	20	12.5 x 15	64
4	20	12.5 x 15	74
5	20	12.5 x 15	28

Sample Unit No.	No. of Slabs	Slab Size	PCI

Average PCI for Feature: 62

Condition Rating: Good

Figure A-27. Feature summary - jointed rigid pavement

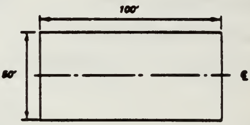
FLEXIBLE PAVEMENT
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT: WORLD INTERNATIONAL			DATE: 5/26/79
FACILITY: TXY E	FEATURE: T-11 R1		SAMPLE UNIT: 4 4
SURVEYED BY: JH/DE		AREA OF SAMPLE: 5000 SQ FT	

DISTRESS TYPES

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST
7. JT. REFLECTION (PCC)
8. LONG. & TRANS. CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING/WEATHERING
13. RUTTING
14. SHOVING FROM PCC
15. SLIPPAGE CRACKING
16. SWELL

SKETCH:



EXISTING DISTRESS TYPES

		1	5	8	12		
		4 X 4 M	6 X 4 L	10 L	3 X 10 M		
		2 X 3 L		5 L			
				15 L			
				5 M			
				10 L			
				5 M			
TOTAL SEVERITY	L	6 SQ FT	24 SQ FT	40 FT			
	M	16 SQ FT		10 FT	30 SQ FT		
	H						

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
1	L	0.12	7
1	M	0.32	19
5	L	0.48	2
8	L	0.80	5
8	M	0.20	5
12	M	0.60	7
DEDUCT TOTAL			45
CORRECTED DEDUCT VALUE (CDV)			25

PCI = 100 – CDV = 75

RATING = VERY GOOD

Figure A-28. Flexible pavements - condition survey data sheet

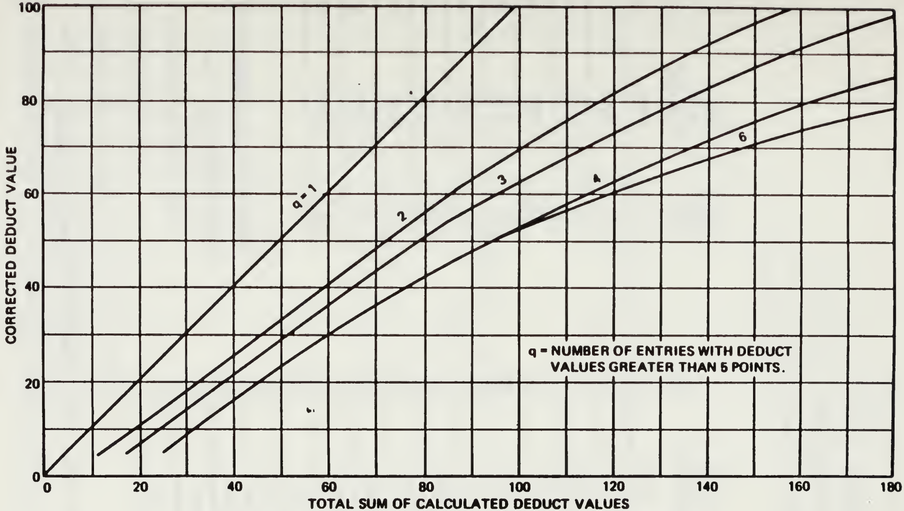


Figure A-45. Corrected deduct values for flexible pavements

J21

Airport: World International

Airport Facility: Taxiway 5

Total No. of Sample Units: 25

Date of Survey: 26 March 1979

Sample Unit No.	Sample Unit Area, ft^2	PCI
1	5000	42
2	5000	33
3	5000	53
4	5000	39
5	5000	23
6	5000	25
7	5000	36
8	5000	38
9	5000	35
10	5000	25
11	5000	32
12	5000	45
13	5000	40
14	5000	55
15	5000	46

Sample Unit No.	Sample Unit Area, ft^2	PCI
16	5000	35
17	5000	22
18	5000	30
19	5000	39
20	5000	35
21	5000	32
22	5000	41
23	5000	49
24	5000	30
25	5000	22

Average PCI for Feature: 36

Condition Rating: Poor

Figure A-46. Feature summary for flexible pavements

APPENDIX B

****

****

PAVEMENT CONDITION SURVEY

FOR

TILLAMOOK AIRPORT

OREGON

JUNE 25-26 1987

INCLUDING:

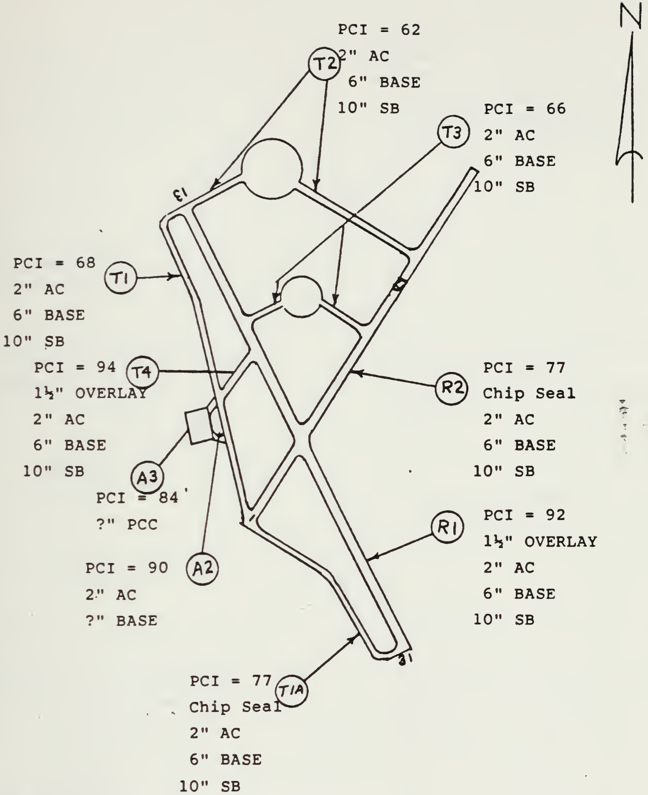
1...FEATURE SUMMARY SHEET

2...AIRPORT LAYOUT

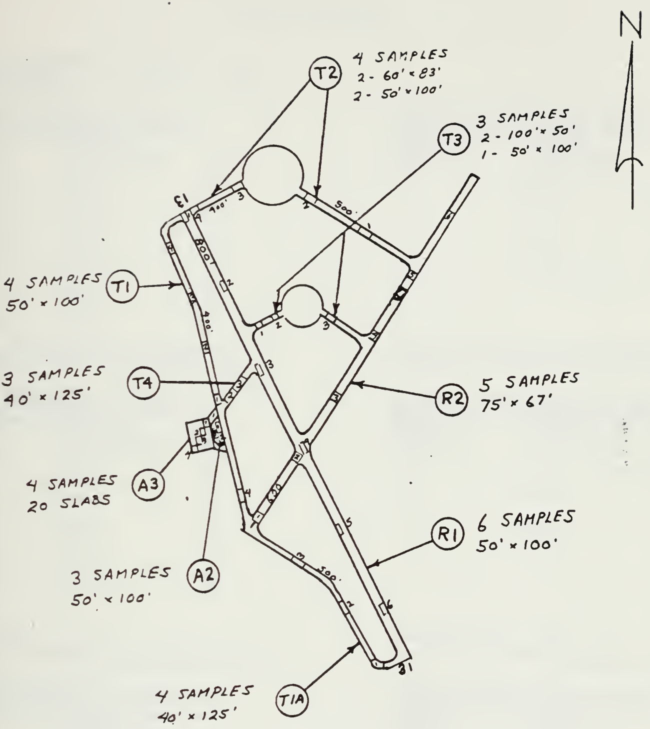
3...VERBAL DESCRIPTION OF AIRPORT HISTORY

4...ACTUAL PAVEMENT CONDITION SURVEYS

5...OVERALL PLANNING AND DEVELOPMENT RECOMMENDATIONS



'ILLAMOOK AIRPORT
'AVEMENT FEATURES AND PCI NUMBERS
'UNE 25-26, 1987



'ILLAMOOK AIRPORT
,OCATION OF SAMPLE AREAS WITHIN EACH FEATURE
'UNE 25-26, 1987

FEATURE SUMMARY

AIRPORT: Tillamook Airport
DATE OF SURVEY: June 25-26, 1987

AIRPORT FACILITY: Runway R-1, 15-33
TOTAL NO. OF SAMPLE UNITS: 6

SAMPLE UNIT NO.	SAMPLE UNIT AREA	PCI
1	5000	86
2	5000	88
3	5000	90
4	5000	95
5	5000	94
6	5000	96

Average PCI: 92
Condition Rating: Excellent

AIRPORT FACILITY: Taxiway T-1 A
TOTAL NO. OF SAMPLE UNITS: 4

SAMPLE UNIT NO.	SAMPLE UNIT AREA	PCI
1	5000	66
2	5000	82
3	5000	78
4	5000	82

Average PCI: 77
Condition Rating: Very Good

AIROPRT FACILITY: Runway R-2 1-19
TOTAL NO. OF SAMPLE UNITS: 5

SAMPLE UNIT NO.	SAMPLE UNIT AREA	PCI
1	5000	66
2	5000	73
3	5000	81
4	5000	82
5	5000	82

Average PCI: 77
Condition Rating: Very Good

AIRPORT FACILITY: Taxiway T-2
TOTAL NO. OF SAMPLE UNITS: 4

SAMPLE UNIT NO.	SAMPLE UNIT AREA	PCI
1	5000	65
2	5000	65
3	5000	57
4	5000	60

Average PCI: 62
Condition Rating: Good

AIRPORT FACILITY: Taxiway T-1
TOTAL NO. OF SAMPLE UNITS: 4

SAMPLE UNIT NO.	SAMPLE UNIT AREA	PCI
1	5000	67
2	5000	72
3	5000	74
4	5000	60

Average PCI: 68
Condition Rating: Good

AIRPORT FACILITY: Taxiway T-3
TOTAL NO. OF SAMPLE UNITS: 3

SAMPLE UNIT NO.	SAMPLE UNIT AREA	PCI
1	5000	67
2	5000	70
3	5000	60

Average PCI: 66
Condition Rating: Good

FEATURE SUMMARY (Continued)

RPORT: Tillamook Airport
TE OF SURVEY: June 25-26, 1987

RPORT FACILITY: Taxiway T-4
TAL NO. OF SAMPLE UNITS: 3

MPLE IT NO.	SAMPLE UNIT AREA	PCI
1	5000	90
2	5000	96
3	5000	96

erage PCI: 94
ndition Rating: Excellent

ROPRT FACILITY: Apron A-2
TAL NO. OF SAMPLE UNITS: 3

MPLE IIT NO.	SAMPLE UNIT AREA	PCI
1	5000	91
2	5000	.91
3	5000	87

rerage PCI: 90
ondition Rating: Excellent

IRPORT FACILITY: Apron A-3
TAL NO. OF SAMPLE UNITS: 4

MPLE NIT NO.	SAMPLE UNIT AREA	PCI
1	20 slabs	80
2	20 slabs	88
3	20 slabs	84
4	20 slabs	85

verage PCI: 84
ondition Rating: Very Good

PRINCIPAL DISTRESSES:

Runway R-1 Nothing significant
Runway R-2 Raveling, depressions and cracking

Taxiway T-1 Block, longitudinal and transverse cracking, depressions and raveling
Taxiway T-1 A Raveling, depressions and cracking
Taxiway T-2 Block, cracking, Longitudina and transverse cracking, depressions and raveling
Taxiway T-3 Longitudinal and transverse cracking, depressions and raveling
Taxiway T-4 Nothing significant

Apron A-2 Nothing significant
Apron A-3 Joint seal damage

TILLAMOOK AIRPORT
PAVEMENT DEVELOPMENT AND MAINTENANCE

The original construction of 1942-43 was a combination of DLAND-USED and Navy. Except for a small concrete apron of unknown thickness, on the west side, all pavements were flexible construction consisting of 2" AC, 6" BASE and 10" SUBBASE. On taxiways and aprons the surface thickness was 2½". It appears nothing was done to the pavement, except for a possible slurry seal on a few sections, until 1983. At that time a Federally funded project assisted in overlay of runway 13-31, and chip seals on runway 1-19 and the southern portion of the taxiway parallel to 13-31. Also, at that time the short taxiway from the concrete apron to runway 13-31 was overlaid. The island between the concrete apron and parallel taxiway was surfaced in some recent year.

Traffic at this airport has consisted mainly of light single and twin engine aircraft but occasionally a large aircraft will visit the airport.

Currently, runway 13-31 is in excellent condition. Runway 1-19 and the south portion of the parallel taxiway, while in very good condition, has a lot of loose stone. These pavements have been swept several times but the chips keep coming loose.

A fog seal is suggested after the next sweeping and eventually a slurry seal for the runway. The aprons are in fine condition but the concrete apron could use new joint seal as it has had nothing done to it in 44 years. All of the other pavements are original, although the north portion of the parallel taxiway looks like it had a slurry seal once, and are in good condition. Typically they have some depressions, fine cracking and raveling. Some have a lot of vegetation in the cracks.

The ideal solution on these pavements would be an overlay as was accomplished on runway 13-31. The active taxiways could be overlaid 35' wide or maybe 40'. This treatment would correct all problems including depressions. But, if funds are insufficient, removing vegetation

and slurry sealing these pavements would be a big improvement. Even though the southern portion of the parallel taxiway received a chip seal, an overlay of the entire taxiway at 35' or 40' would be desirable.

SUGGESTED PAVEMENT PROGRAM IS AS FOLLOWS:

Overlay parallel taxiway to runway 13-31 approx. 5500' x 35'			
21,389 S.Y. @ $ 6.00	=	$	128,300.
Fog seal runway 1-19			
23,333 s.y. @ $ 0.20	=	$	4,700.
Slurry seal taxiways between runways to 40' width			
15,000 s.y. @ $ 2.00	=	$	30,000.
Replace joint seal in concrete apron	=	$	9,000.

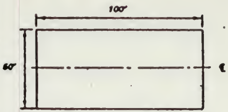
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT: TILLAMOOK	DATE: 6-26-87
FACILITY: Runway 13-31	FEATURE: R1
SAMPLE UNIT: 1	
SURVEYED BY: RB/RE	AREA OF SAMPLE: 5000

DISTRESS TYPES

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST
7. JT. REFLECTION (PCC)
8. LONG. & TRANS. CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING/WEATHERING
13. RUTTING
14. SHOVING FROM PCC
15. SLIPPAGE CRACKING
16. SWELL

SKETCH:



EXISTING DISTRESS TYPES

	3	12				
	120 L	2% L				
TOTAL SEVERITY L	120'	2%				
TOTAL SEVERITY M						
TOTAL SEVERITY H						

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
3	L	2.4	10
12	L	2.0	4
DEDUCT TOTAL			14
CORRECTED DEDUCT VALUE (CDV)			14

PCI = 100 − CDV = 86

RATING = EXCELLENT

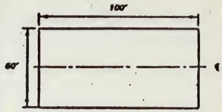
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT:	DATE:
FACILITY:	FEATURE:
SAMPLE UNIT: 2	
SURVEYED BY:	AREA OF SAMPLE:

DISTRESS TYPES

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST
7. JT. REFLECTION (PCC)
8. LONG. & TRANS. CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING/WEATHERING
13. RUTTING
14. SHOVING FROM PCC
15. SLIPPAGE CRACKING
16. SWELL

SKETCH:



EXISTING DISTRESS TYPES

	3	12				
	70 L	2% L				
TOTAL SEVERITY L	70'	2%				
TOTAL SEVERITY M						
TOTAL SEVERITY H						

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
3	L	1.4	8
12	L	2.0	4
DEDUCT TOTAL			12
CORRECTED DEDUCT VALUE (CDV)			12

PCI = 100 − CDV = 88

RATING = EXCELLENT

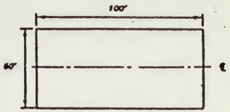
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT TILLAMOOK		DATE 6-26-87
FACILITY Runway 13-31	FEATURE R1	SAMPLE UNIT 3
SURVEYED BY PB/RB	AREA OF SAMPLE 5000	

DISTRESS TYPES

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST
7. JT. REFLECTION (PCC)
8. LONG. & TRANS. CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING/WEATHERING
13. RUTTING
14. SHOVING FROM PCC
15. SLIPPAGE CRACKING
16. SWELL

SKETCH:



EXISTING DISTRESS TYPES

	12	3				
	2% L	20 L				
TOTAL SEVERITY L	2%	20 S'				
M						
H						

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
3	L	0.4	6
12	L	2.0	4
DEDUCT TOTAL			10
CORRECTED DEDUCT VALUE (CDV)			10

PCI = 100 − CDV = 90

RATING = EXCELLENT

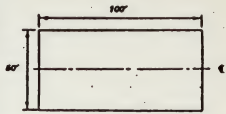
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT		DATE
FACILITY	FEATURE	SAMPLE UNIT 4
SURVEYED BY	AREA OF SAMPLE	

DISTRESS TYPES

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST
7. JT. REFLECTION (PCC)
8. LONG. & TRANS. CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING/WEATHERING
13. RUTTING
14. SHOVING FROM PCC
15. SLIPPAGE CRACKING
16. SWELL

SKETCH:



EXISTING DISTRESS TYPES

	12	5				
	2% L	4' L				
TOTAL SEVERITY L	2%	4 S'				
M						
H						

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
5	L	0.1	1
12	L	2.0	4
DEDUCT TOTAL			5
CORRECTED DEDUCT VALUE (CDV)			5

PCI = 100 − CDV = 95

RATING = EXCELLENT

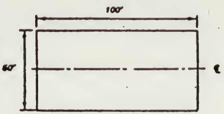
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT TILLAMOOK			DATE 6-26-87
FACILITY Runway 13-31	FEATURE R1	SAMPLE UNIT 5	
SURVEYED BY RB/KB		AREA OF SAMPLE 5000	

DISTRESS TYPES

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST
7. JT. REFLECTION (PCC)
8. LONG. & TRANS. CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING/WEATHERING
13. RUTTING
14. SHOVING FROM PCC
15. SLIPPAGE CRACKING
16. SWELL

SKETCH:



EXISTING DISTRESS TYPES

	12 3% L					
TOTAL SEVERITY L	3%					
TOTAL SEVERITY M						
TOTAL SEVERITY H						

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
12	L	3.0	6
DEDUCT TOTAL			6
CORRECTED DEDUCT VALUE (CDV)			6

PCI = 100 − CDV = 94

RATING = EXCELLENT

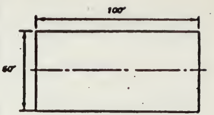
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT			DATE
FACILITY	FEATURE	SAMPLE UNIT 6	
SURVEYED BY		AREA OF SAMPLE	

DISTRESS TYPES

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST
7. JT. REFLECTION (PCC)
8. LONG. & TRANS. CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING/WEATHERING
13. RUTTING
14. SHOVING FROM PCC
15. SLIPPAGE CRACKING
16. SWELL

SKETCH:



EXISTING DISTRESS TYPES

	12 2% L					
TOTAL SEVERITY L	2%					
TOTAL SEVERITY M						
TOTAL SEVERITY H						

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
12	L	2.0	4
DEDUCT TOTAL			4
CORRECTED DEDUCT VALUE (CDV)			4

PCI = 100 − CDV = 96

RATING = EXCELLENT

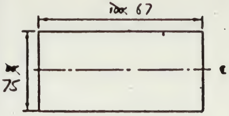
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT: TILLAMOOK	DATE: 6-25-87
FACILITY: Runway 1-19	FEATURE: R2
SAMPLE UNIT: 1	
SURVEYED BY: RB/FB	AREA OF SAMPLE: 5000

DISTRESS TYPES

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST
7. JT. REFLECTION (PCC)
8. LONG. & TRANS. CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING/WEATHERING
13. RUTTING
14. SHOVING FROM PCC
15. SLIPPAGE CRACKING
16. SWELL

SKETCH.



EXISTING DISTRESS TYPES

	8	5	12			
	39 5 L	150 L	10% M			
TOTAL SEVERITY L	375'	180 s'				
TOTAL SEVERITY M			10%			
TOTAL SEVERITY H						

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
5	L	3.6	17
8	L	7.7	19
12	M	10.0	21
DEDUCT TOTAL			57
CORRECTED DEDUCT VALUE (CDV)			34

PCI = 100 − CDV = 66

RATING = GOOD

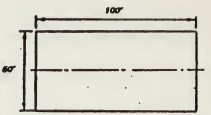
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT:	DATE:
FACILITY:	FEATURE:
SAMPLE UNIT: 2	
SURVEYED BY:	AREA OF SAMPLE:

DISTRESS TYPES

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST
7. JT. REFLECTION (PCC)
8. LONG. & TRANS. CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING/WEATHERING
13. RUTTING
14. SHOVING FROM PCC
15. SLIPPAGE CRACKING
16. SWELL

SKETCH:



EXISTING DISTRESS TYPES

	5	8	12			
	40 L	292 L	5% M			
	75 L					
	30 L					
TOTAL SEVERITY L	145 s'	292'				
TOTAL SEVERITY M			8%			
TOTAL SEVERITY H						

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
5	L	2.9	14
8	L	5.8	15
12	M	8.0	18
DEDUCT TOTAL			47
CORRECTED DEDUCT VALUE (CDV)			27

PCI = 100 − CDV = 73

RATING = VERY GOOD

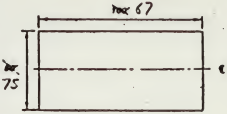
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT: TILLAMOOK		DATE: 6-25-87
FACILITY: Runway 1-19	FEATURE: R2	SAMPLE UNIT: 3
SURVEYED BY: RB/RB	AREA OF SAMPLE: 5000	

DISTRESS TYPES

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST
7. JT. REFLECTION (PCC)
8. LONG. & TRANS. CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING/WEATHERING
13. RUTTING
14. SHOVING FROM PCC
15. SLIPPAGE CRACKING
16. SWELL

SKETCH:



EXISTING DISTRESS TYPES

	5	8	12		
	90 L	93 L	8% M		
	15 L				
TOTAL SEVERITY L	105'	93'			
TOTAL SEVERITY M			8%		
TOTAL SEVERITY H					

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
5	L	2.1	12
8	L	1.9	7
12	M	8.0	18
DEDUCT TOTAL			37
CORRECTED DEDUCT VALUE (CDV)			19

PCI = 100 − CDV = 81

RATING = VERY GOOD

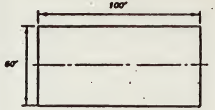
CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT:		DATE:
FACILITY:	FEATURE:	SAMPLE UNIT: 4
SURVEYED BY:	AREA OF SAMPLE:	

DISTRESS TYPES

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST
7. JT. REFLECTION (PCC)
8. LONG. & TRANS. CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING/WEATHERING
13. RUTTING
14. SHOVING FROM PCC
15. SLIPPAGE CRACKING
16. SWELL

SKETCH:



EXISTING DISTRESS TYPES

	8	5	12		
	148 L	30 L	8% M		
		15 L			
		25 L			
TOTAL SEVERITY L	148'	70 s'			
TOTAL SEVERITY M			8 %		
TOTAL SEVERITY H					

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
5	L	1.4	8
8	L	3.0	9
12	M	8.0	18
DEDUCT TOTAL			35
CORRECTED DEDUCT VALUE (CDV)			18

PCI = 100 − CDV = 82

RATING = VERY GOOD

FLEXIBLE PAVEMENT

CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT: TILLAMOOK | DATE: 6-25-87
FACILITY: Runway 1-19 | FEATURE: R2 | SAMPLE UNIT: 5
SURVEYED BY: RB/PC | AREA OF SAMPLE: 5000

DISTRESS TYPES

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST
7. JT. REFLECTION (PCC)
8. LONG. & TRANS. CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING/WEATHERING
13. RUTTING
14. SHOVING FROM PCC
15. SLIPPAGE CRACKING
16. SWELL

SKETCH: ~~100'~~ 67 × ~~50'~~ 75 ℄

EXISTING DISTRESS TYPES

	8	5	12			
	306 L	20 L	10% M			
		25 L				
		40 L				
TOTAL SEVERITY L	306'	85 s'				
TOTAL SEVERITY M			10%			
TOTAL SEVERITY H						

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
5	L	1.7	10
8	L	6.1	17
12	M	10.0	21
DEDUCT TOTAL			48
CORRECTED DEDUCT VALUE (CDV)			28

PCI = 100 − CDV = 82

RATING = VERY GOOD

134

FLEXIBLE PAVEMENT

CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT

AIRPORT: | DATE:
FACILITY: | FEATURE: | SAMPLE UNIT: 6
SURVEYED BY: | AREA OF SAMPLE:

DISTRESS TYPES

1. ALLIGATOR CRACKING
2. BLEEDING
3. BLOCK CRACKING
4. CORRUGATION
5. DEPRESSION
6. JET BLAST
7. JT. REFLECTION (PCC)
8. LONG. & TRANS. CRACKING
9. OIL SPILLAGE
10. PATCHING
11. POLISHED AGGREGATE
12. RAVELING/WEATHERING
13. RUTTING
14. SHOVING FROM PCC
15. SLIPPAGE CRACKING
16. SWELL

SKETCH: 100' × 50'

EXISTING DISTRESS TYPES

	5	8	12			
	50 L	169 L	80% M			
	20 L					
TOTAL SEVERITY L	70 s'	169'				
TOTAL SEVERITY M			80%			
TOTAL SEVERITY H						

PCI CALCULATION

DISTRESS TYPE	SEVERITY	DENSITY %	DEDUCT VALUE
5	L	1.4	8
8	L	3.4	10
12	M	80.	53
DEDUCT TOTAL			71
CORRECTED DEDUCT VALUE (CDV)			44

PCI = 100 − CDV = 56

RATING = GOOD

APPENDIX C

****

****

PAVEMENT CONDITION SURVEY DATA

FOR

WASHINGTON

****

INCLUDING:

1) AIRPORT LOCATION AND DESCRIPTION
2) PAVEMENT IDENTIFICATION
3) ORIGINAL CONSTRUCTION DATE
4) ORIGINAL STRUCTURAL SECTION
5) AVERAGE PCI VALUE OF PAVEMENT FEATURE
6) DATE OF PAVEMENT CONDITION SURVEY
7) DESCRIPTION OF REPAIRS AND REHABILITATION
8) DATE OF REPAIRS OR REHABILITATION
9) DESCRIPTION OF THE EXISTING PAVEMENT FEATURE
10) COMMENTS PERTINENT TO EACH PAVEMENT FEATURE

NO.	AIRPORT LOCATION AND DESCRIPTION	PAVEMENT IDENT.	ORIGINAL CONSTRUCTION DATE	ORGINAL STRUCTURAL SECTION	PCI AVE %	PCI DATE
1	ANACORTES AP	R1	1968	DBST,7.5"B	96	1986
2	ANACORTES AP	R2	1968	DBST,7.5"B	95	1986
3	ANACORTES AP	R3	1968	DBST,7.5"B	100	1986
4	ARLINGTON MUNICIPAL AP	R1	1942	2"AC,6"B	77	1986
5	ARLINGTON MUNICIPAL AP	R2	1942	3"AC,8"B	89	1986
6	AUBURN MUNICIPAL AP	R1	1968	2"AC,18"B	81	1987
7	AUBURN MUNICIPAL AP	R2	1983	2"AC,3"B,11"SB	90	1987
8	BLAINE MUNICIPAL AP	R1	1972	2"AC,8"B	72	1988
9	BOWERMAN FIELD, HOQUIAM	R1	1943	2.5"AC,12"B	77	1986
10	BOWERMAN FIELD, HOQUIAM	R2	1943	8"-6"-8"PCC	86	1986
11	BOWERMAN FIELD, HOQUIAM	R3	1943	8"-6"-8"PCC	33	1986
12	BOWERS FIELD, ELLENSBURG	R1	1976	3"AC,6.5"B	67	1986
13	BOWERS FIELD, ELLENSBURG	R1A	1942	3.5"AC,6"B	46	1986
14	BOWERS FIELD, ELLENSBURG	R2	1942	3"AC,6.5"B	67	1986
15	BOWERS FIELD, ELLENSBURG	R3	1942	2.5"AC,6"B	57	1986
16	BOWERS FIELD, ELLENSBURG	R4	1942	2.5"AC,3"B,5"SB	54	1986
17	BREMERTON NATIONAL AP	R1	1942	2.5"AC,6"B	86	1987
18	BREMERTON NATIONAL AP	R2	1942	3"AC,2.5"B,6"SB	83	1987
19	BREMERTON NATIONAL AP	R3	1942	5"AC,4"B,6"SB	86	1987
20	BREMERTON NATIONAL AP	R4	1942	3"AC,4"B,6"SB	88	1987
21	BREMERTON NATIONAL AP	R5	1942	2.5"AC,6"B	82	1987
22	CASHMERE-DRYDEN AP	R1	1951	TBST,9"B	72	1988
23	CHEHALIS-CENTRALIA AP	R1	1942	8-6-8"PCC,6"SB	84	1987
24	CHEHALIS-CENTRALIA AP	R2	1942	8-6-8"PCC,6"SB	78	1987
25	CLE ELUM MUNICIPAL AP	R1	1987	TBST,4"B	56	1988
26	COLVILLE MUNICIPAL AR	R1	1949	DBST,8"B	33	1986
27	CONCRETE MUNICIPAL AP	R1	1974	DBST,2"B,4"SB	61	1986
28	CONNEL CITY AP	R1	1970	BST,?B	69	1987
29	CREST AP	R1	1967	BST,GRAVEL	97	1987
30	DAVENPORT AP	R1	1973	BST,8"PRB	82	1986
31	DEER PARK AP	R1	1943	1.5"AC,6"B	45	1986
32	DEER PARK AP	R2	1976	2"AC,6"B	72	1986
33	DEER PARK AP	R3	1943	1.5"AC,6"B	47	1986
34	ELMA MUNICIPAL AP	R1	1976	1.5"AC,3"B	88	1988
35	EPHRATA MUNICIPAL AP	R1	1943	6"PCC,6"SB	40	1987
36	EPHRATA MUNICIPAL AP	R1A	1943	3"AC,6"B	60	1987
37	EPHRATA MUNICIPAL AP	R2	1943	2.5"AC,6"B	53	1987
38	EPHRATA MUNICIPAL AP	R2A	1943	6"PCC,6"SB	47	1987
39	EPHRATA MUNICIPAL AP	R2B	1983	3"AC,7"B,12"SB	89	1987
40	EVERGREEN FIELD	R1	1967	2"AC,4"B	55	1987
41	EVERGREEN FIELD	R2	1971	2"AC,4"B	86	1987
42	FERRY COUNTY (REPUBLIC)AP	R1	1974	BST,5"B,6"SB	65	1986
43	GRAND COULY DAM AP	R1	1972	BST,6"B	86	1986
44	GRAND COULY DAM AP	R2	1980	2"AC,5"B	84	1986
45	HARVEY FIELD	R1	1970	2"AC,12"B	64	1988
46	IONE MUNICIPAL AP	R1	1973	BST,4"B,8"PRB	76	1986
47	KELSO-LONGVIEW AP	R1	1983	3"AC,5"B,9"SB	90	1987
48	KENNEWICK-VISTA FIELD	R1	1942	2"AC,6"B	69	1987
49	KENNEWICK-VISTA FIELD	R2	1942	2"AC,6"B	68	1987
50	LAKE CHELAN AP	R1	UNK	UNK	93	1988
51	LIND AP	R1	1971	DBST,3"B	51	1987
52	MANSFIELD AP	R1	1973	BST,4"B	35	1988
53	MOSES LAKE MUNICIPAL AP	R1	1961	DBST,6"B	89	1987
54	MOSES LAKE MUNICIPAL AP	R2	1973	.75"AC,B	29	1987
55	NEW WARDEN AP	R1	1977	2'AC,6"B	77	1987
56	OAK HARBOR AIR PARK	R1	1969	SC,3"B,7"SB	73	1988

NO.	AIRPORT LOCATION AND DESCRIPTION	PAVEMENT IDENT.	ORIGINAL CONSTRUCTION DATE	ORGINAL STRUCTURAL SECTION	PCI AVE %	PCI DATE
57	OCEAN SHORES AP	R1	1985	DBST,8"B	98	1986
58	ODESSA MUNICIPAL AP	R1	1970	DBST,3"B	79	1987
59	ODESSA MUNICIPAL AP	R1A	1970	DBST,3"B	58	1987
60	OKANAGAN LEGION AP	R1	1955	BST,2"B	76	1987
61	OLYMPIA AP	R1	1942	2.5"AC,6"B	55	1988
62	OLYMPIA AP	R2	1980	3"AC,10"B,6"SB	89	1988
63	OLYMPIA AP	R3	1942	2.5"AC,6"B	86	1988
64	OTHELLO MUNICIPAL AP	R1	UNK	BST,3"B	79	1987
65	OMAK AP	R1	1943	4.5"AC,12"B	68	1986
66	PACKWOOD AP	R1	1975	BST,B	94	1988
67	PANGBORN FIELD-WENATCHEE	R1	1947	2"AC,7"B	63	1988
68	PANGBORN FIELD-WENATCHEE	R2	1947	3"AC,8"B	66	1988
69	PANGBORN FIELD-WENATCHEE	R4	1947	2"AC,7"B	55	1988
70	PANGBORN FIELD-WENATCHEE	R5	1978	3"AC,6"B	90	1988
71	PEARSON AIRPARK	R1	1966	1.5"AC,?B	58	1987
72	PEARSON AIRPARK	R2	1966	1.5"AC,?B	84	1987
73	PIERCE COUNTY AP	R1	1958	1.5"AC,2"CB,GSB	64	1986
74	PORT OF ILWACO AP	R1	1971	AC,B	71	1986
75	PORT OF WILLIPA HARBOR AP	R1	1948	BST,3"BSB,5"SB	72	1986
76	PORT OF WILLIPA HARBOR AP	R2	1948	BST,3"BSB,7"SB	68	1986
77	PROSSER AP	R1	1977	2"AC,6"B,1.5"SB	88	1987
78	PRU FIELD - RITZVILLE	R1	1978	TBST,?B	83	1987
79	PULLMAN-MOSCOW REGIONAL AP	R1	1948	2"AC,8"B,7"SB	75	1986
80	PULLMAN-MOSCOW REGIONAL AP	R2	1968	3"AC,15.5"B	70	1986
81	PULLMAN-MOSCOW REGIONAL AP	R3	1968	4"AC,19"B	81	1986
82	QUILLAYUTE STATE	R1	UNK	6"PCC	72	1986
83	QUINCY MUNICIPAL AP	R1	1977	BST,3"B	72	1987
84	QUINCY MUNICIPAL AP	R2	1977	BST,3"B	31	1987
85	RICHLAND AP	R1	1943	2"AC,6"B	86	1987
86	RICHLAND AP	R2	1943	2"AC,8"B	84	1987
87	RICHLAND AP	R3	1979	3"AC,3"B,4"SB	86	1987
88	ROSALIA MUNICIPAL AP	R1	1985	SS,BST,3"B,3.5"SB	68	1987
89	SANDERSON FIELD,SHELTON	R1	1942	2"AC,6'B	77	1988
90	SEKIU AP	R1	1972	2"AC,6"B	68	1988
91	SEKIU AP	R2	1979	2"AC,6"B	88	1988
92	SEQUIM VALLEY AP	R1	1985	DBST,12"PRG	52	1988
93	SKAGIT REGIONAL AP	R1	1942	2"AC,4"B,6"SB	69	1986
94	SKAGIT REGIONAL AP	R2	1942	2"AC,4"B,12"SB	64	1986
95	STORM FIELD, MORTON	R1	1970	BST,B	73	1988
96	SUNNYSIDE MUNICIPAL AP	R1	1975	3"AC,6"B	85	1987
97	WALLA WALLA CITY COUNTY AP	R1	1942	6.5"PCC,6"SB	81	1987
98	WALLA WALLA CITY COUNTY AP	R2	1942	6.5"PCC,6"SB	58	1987
99	WALLA WALLA CITY COUNTY AP	R4	1942	6.5"PCC,6"SB	60	1987
100	WATERVILLE AP	R1	1976	BST,6"B	65	1988
101	WHITMAN COUNTY MEORIAL AP	R1	1970	BST,6"B	57	1986
102	WILBUR AP	R1	1971	BST,6"B	92	1986
103	WILLIAM R FAIRCHILD INT.AP	R1	1942	2"AC,6"AB	79	1988
104	WILLIAM R FAIRCHILD INT.AP	R2	1942	2"AC,6"AB	86	1988
105	WILLIAM R FAIRCHILD INT.AP	R4	1942	2"AC,6"AB	94	1988
106	WILLARD-TEKOA FIELD	R1	1975	2"AC,4"B,12"SB	90	1986
107	WINLOCK AP	R1	1943	2"AC,8"B	49	1986
108	WOODLAND STATE AP	R1	1984	TBST,?B	91	1987

[illegible]

NO.	AIRPORT LOCATION AND DESCRIPTION	REPAIR/ REHAB. TYPE #1	R AND R #1 DATE	REPAIR/ REHAB. TYPE #2	R AND R #2 DATE	EXISTING PAVEMENT STRUCTURE
1	ANACORTES AP	2"AC OL	1973			2"AC OL,DBST,7.5"B
2	ANACORTES AP	2",3",7"	1973	SEE NOTE		2"AC,3"B,7"SB
3	ANACORTES AP	2",4",6"	1973	SEE NOTE		2"AC,4"B,6"SB
4	ARLINGTON MUNICIPAL AP					2"AC,6"B
5	ARLINGTON MUNICIPAL AP	2"AC OL	1976			2"AC OL,3"AC,8"B
6	AUBURN MUNICIPAL AP					2"AC,18"B
7	AUBURN MUNICIPAL AP					2"AC,3"B,11"SB
8	BLAINE MUNICIPAL AP					2"AC,8"B
9	BOWERMAN FIELD, HOQUIAM					2.5"AC,12"B
10	BOWERMAN FIELD, HOQUIAM					8"-6"-8"PCC
11	BOWERMAN FIELD, HOQUIAM					8"-6"-8"PCC
12	BOWERS FIELD, ELLENSBURG					3"AC,6.5"B
13	BOWERS FIELD, ELLENSBURG					3.5"AC,6"B
14	BOWERS FIELD, ELLENSBURG					3"AC,6.5"B
15	BOWERS FIELD, ELLENSBURG					2.5"AC,6"B
16	BOWERS FIELD, ELLENSBURG					2.5"AC,3"B,5"SB
17	BREMERTON NATIONAL AP	3"AC OL	SEE NOTE	CRACK S	1983	3"OL,2.5"AC,6"B
18	BREMERTON NATIONAL AP	5"AC OL	SEE NOTE	CRACK S	1983	5"OL,3"AC,2.5"B,6"SB
19	BREMERTON NATIONAL AP		SEE NOTE	CRACK S	1983	5"AC,4"B,6"SB
20	BREMERTON NATIONAL AP	2"AC OL	SEE NOTE	CRACK S	1983	2"OL,3"AC,4"B,6"SB
21	BREMERTON NATIONAL AP		SEE NOTE			2.5"AC,6"B
22	CASHMERE-DRYDEN AP	SC	1971/76	SC	1979	DBST,SC,SC,SC,TBST,9"B
23	CHEHALIS-CENTRALIA AP					8"-6"-8"PCC,6"SB
24	CHEHALIS-CENTRALIA AP					8"-6"-8"PCC,6"SB
25	CLE ELUM MUNICIPAL AP					TBST,4"B (POOR TBST)
26	COLVILLE MUNICIPAL AR	SC	1958			SC,DBST,8"B
27	CONCRETE MUNICIPAL AP					DBST,2"B,4"SB
28	CONNEL CITY AP	2"AC OL	1979			2"AC OL,BST,?B
29	CREST AP	2'AC OL	1986			2"AC OL,BST,GRAVEL
30	DAVENPORT AP	BST	1977	SC	1984	TBST,8"B
31	DEER PARK AP					1.5"AC,6"B
32	DEER PARK AP					2"AC,6"B
33	DEER PARK AP					1.5"AC,6"B
34	ELMA MUNICIPAL AP					1.5"AC,3"B
35	EPHRATA MUNICIPAL AP					6"PCC,6"SB
36	EPHRATA MUNICIPAL AP	SS	1970			SS,3"AC,6"B
37	EPHRATA MUNICIPAL AP	SS	1970			SS,2.5"AC,6"B
38	EPHRATA MUNICIPAL AP					6"PCC,6"SB
39	EPHRATA MUNICIPAL AP	SEE NOTE				3"AC,7"B,12"SB
40	EVERGREEN FIELD					2"AC,4"B
41	EVERGREEN FIELD					2"AC,4"B
42	FERRY COUNTY (REPUBLIC)AP	CS	1978			CS,BST,5"B6"SB
43	GRAND COULY DAM AP	E	1975	2"AC OL	1980	2"AC OL,BST,6"B
44	GRAND COULY DAM AP					2"AC,5"B
45	HARVEY FIELD	SC	1982			SC,2"AC,12"B
46	IONE MUNICIPAL AP	SC	UNK	SC	UK	TBST,4"AC,8"PRB
47	KELSO-LONGVIEW AP					3"AC,5"B,9"SB
48	KENNEWICK-VISTA FIELD	CS	1976			CS,2"AC,6"B
49	KENNEWICK-VISTA FIELD					2"AC,6"B
50	LAKE CHELAN AP	2"AC.5"B	1986			2"AC,5"B
51	LIND AP	SS	1973	SS	1982	SS,SS,BST,3"B
52	MANSFIELD AP	CS	1979	CS	1983	CS,CS,BST,4"B
53	MOSES LAKE MUNICIPAL AP	SS	1974	2"AC OL	1984	2"AC 0L,SS,DBST,6"B
54	MOSES LAKE MUNICIPAL AP	SEE NOTE				.75"AC, UNKNOWN BASE
55	NEW WARDEN AP					2'AC,6"B
56	OAK HARBOR AIR PARK	2"AC OL	1971			2"AC,SC,3"B,7"SB

NO.	AIRPORT LOCATION AND DESCRIPTION	REPAIR/ REHAB. TYPE #1	R AND R #1 DATE	REPAIR/ REHAB. TYPE #2	R AND R #2 DATE	EXISTING PAVEMENT STRUCTURE
57	OCEAN SHORES AP					DBST,8"B
58	ODESSA MUNICIPAL AP	SC	1974	DBST,6"B	1985	DBST,6"B
59	ODESSA MUNICIPAL AP	SC	1974	BST	1985	TBST,3"B
60	OKANAGAN LEGION AP	BST	1962	BST	1980	5 BST,2"B
61	OLYMPIA AP					2.5"AC,6"B
62	OLYMPIA AP					3"AC,10"B,6"SB
63	OLYMPIA AP	3"AC OL	1980			3"AC OL,10"B,6"SB
64	OTHELLO MUNICIPAL AP	2"AC OL	1976			2"AC OL,BST,3"B
65	OMAK AP	2.5"ACOL	1974			2.5"AC OL,4.5"AC,12"B
66	PACKWOOD AP	2"AC,2'A	1985			2"AC,2"B,BST,GRAVEL
67	PANGBORN FIELD-WENATCHEE	UNK	1966	CS	1974	CS,2"AC,7"B
68	PANGBORN FIELD-WENATCHEE	UNK	1966	CS	1974	CS,3"AC,8"B
69	PANGBORN FIELD-WENATCHEE					2"AC,7"B
70	PANGBORN FIELD-WENATCHEE					3"AC,6"B
71	PEARSON AIRPARK	SC	1975			CS,1.5"AC,?B
72	PEARSON AIRPARK	SC	1975			CS,1.5"AC,?B
73	PIERCE COUNTY AP					1.5"AC,2"CB,GSB
74	PORT OF ILWACO AP					1.5"AC,GRAVEL BASE
75	PORT OF WILLIPA HARBOR AP	BST	1970	BST	1976	1"AC,3"BSB,5"SB
76	PORT OF WILLIPA HARBOR AP	BST	1970	BST	1976	1.25"AC,3"BSB,7"SB
77	PROSSER AP	CS	1981			CS,2"AC,6"B,1.5"SB
78	PRU FIELD - RITZVILLE	SC	1985			SC,TBST,?B
79	PULLMAN-MOSCOW REGIONAL AP	2"ACOL	1972	GROOVED	1985	2"AC OL,2"AC,8"B,7"SB
80	PULLMAN-MOSCOW REGIONAL AP			GROOVED	1985	3"AC,15.5"B
81	PULLMAN-MOSCOW REGIONAL AP			GROOVED	1985	4"AC,19"SB
82	QUILLAYUTE STATE					6"PCC
83	QUINCY MUNICIPAL AP	SS	1980			SS,BST,3"B
84	QUINCY MUNICIPAL AP					BST,3"B
85	RICHLAND AP	2'AC OL	1979			2"AC OL,2"AC,6"B
86	RICHLAND AP	2'AC OL	1979			2"AC OL,2"AC,8"B
87	RICHLAND AP					3"AC,3"B,4"SB
88	ROSALIA MUNICIPAL AP					SS,BST,3"B,3.5"SB
89	SANDERSON FIELD,SHELTON	SS	1979			SS,2"AC,6"B
90	SEKIU AP	CS,SAND	1987			CS,SAND S,2"AC,6"B
91	SEKIU AP	CS,SAND	1987			CS,SAND S,2"AC,6"B
92	SEQUIM VALLEY AP					DBST,12"PRG
93	SKAGIT REGIONAL AP					2"AC,4"B,6"SB
94	SKAGIT REGIONAL AP					2"AC,4"B,12"SB
95	STORM FIELD, MORTON	SS	UNK	DBST	1987	DBST,GA,BST,B
96	SUNNYSIDE MUNICIPAL AP	SS	1985			SS,3"AC,6"B
97	WALLA WALLA CITY COUNTY AP	1.5"AC	1970	1"PFC	1970	1.5"AC,1"PFC,6.5"PCC,6"B
98	WALLA WALLA CITY COUNTY AP					6.5"PCC,6"SB
99	WALLA WALLA CITY COUNTY AP					6.5"PCC,6"SB
100	WATERVILLE AP	SC	1983			SC,BST,6"B
101	WHITMAN COUNTY MEORIAL AP	SS	1981			SS,BST,6"B
102	WILBUR AP	SC	1983	2"AC OL	1985	2"AC OL,SC,BST,6"B
103	WILLIAM R FAIRCHILD INT.AP	SS	1952	2"AC OL	1979	PFC,2"OL,SS,2"AC,6"B
104	WILLIAM R FAIRCHILD INT.AP	SS	1952	2"AC OL	1979	PFC,2"OL,SS,2"AC,6"B
105	WILLIAM R FAIRCHILD INT.AP	SS	1952	2"AC OL	1978	2"OL,SS,2"AC,6"B
106	WILLARD-TEKOA FIELD					2"AC,4"B,12"SB
107	WINLOCK AP					2"AC,8"B
108	WOODLAND STATE AP					TBST,?B

AIRPORT NO.	LOCATION AND DESCRIPTION	COMMENTS
1	ANACORTES AP	
2	ANACORTES AP	RECONSTRUCTED IN 1973 HOW IS UNKNOWN
3	ANACORTES AP	RECONSTRUCTED IN 1973 HOW IS UNKNOWN
4	ARLINGTON MUNICIPAL AP	
5	ARLINGTON MUNICIPAL AP	
6	AUBURN MUNICIPAL AP	
7	AUBURN MUNICIPAL AP	
8	BLAINE MUNICIPAL AP	
9	BOWERMAN FIELD, HOQUIAM	
10	BOWERMAN FIELD, HOQUIAM	CONCRETE
11	BOWERMAN FIELD, HOQUIAM	CONCRETE
12	BOWERS FIELD, ELLENSBURG	RECONSTRUCTED IN 1973
13	BOWERS FIELD, ELLENSBURG	
14	BOWERS FIELD, ELLENSBURG	
15	BOWERS FIELD, ELLENSBURG	
16	BOWERS FIELD, ELLENSBURG	
17	BREMERTON NATIONAL AP	OL PLACED ON VARIOUS SECTIONS 1960,1963,1972,1974
18	BREMERTON NATIONAL AP	OL PLACED ON VARIOUS SECTIONS 1960,1963,1972,1974
19	BREMERTON NATIONAL AP	OL PLACED ON VARIOUS SECTIONS 1960,1963,1972,1974
20	BREMERTON NATIONAL AP	OL PLACED ON VARIOUS SECTIONS 1960,1963,1972,1974
21	BREMERTON NATIONAL AP	CURRENTLY CLOSED
22	CASHMERE-DRYDEN AP	DBST ADDED IN 1984
23	CHEHALIS-CENTRALIA AP	CONRETE RUNWAY
24	CHEHALIS-CENTRALIA AP	CONRETE RUNWAY
25	CLE ELUM MUNICIPAL AP	ORIG. 1948 WITH A COAL SHELL MATERIAL, PAVED IN 1987
26	COLVILLE MUNICIPAL AR	
27	CONCRETE MUNICIPAL AP	ORIG. GRADED STRIP, SOIL CEMENT ADDED AFTER 1947
28	CONNEL CITY AP	BASE THICKNESS IS UNKNOWN
29	CREST AP	DEPTH OF THE BASE IS UNKNOWN
30	DAVENPORT AP	SEAL COAT CONSISTED OF 3/8" TO 1/4" ROAD MIX
31	DEER PARK AP	
32	DEER PARK AP	RECONSTRUCTED IN 1976
33	DEER PARK AP	
34	ELMA MUNICIPAL AP	
35	EPHRATA MUNICIPAL AP	
36	EPHRATA MUNICIPAL AP	
37	EPHRATA MUNICIPAL AP	
38	EPHRATA MUNICIPAL AP	
39	EPHRATA MUNICIPAL AP	RECONSTRUCTED IN 1973, ORIG. 2.5"AC,6"B
40	EVERGREEN FIELD	
41	EVERGREEN FIELD	
42	FERRY COUNTY (REPUBLIC)AP	
43	GRAND COULY DAM AP	
44	GRAND COULY DAM AP	WIDENED THE RUNWAY
45	HARVEY FIELD	
46	IONE MUNICIPAL AP	INFORMATION ?
47	KELSO-LONGVIEW AP	
48	KENNEWICK-VISTA FIELD	
49	KENNEWICK-VISTA FIELD	
50	LAKE CHELAN AP	
51	LIND AP	
52	MANSFIELD AP	
53	MOSES LAKE MUNICIPAL AP	
54	MOSES LAKE MUNICIPAL AP	BASE IS UNKNOWN, INFO IS SHAKY
55	NEW WARDEN AP	
56	OAK HARBOR AIR PARK	

AIRPORT NO.	LOCATION AND DESCRIPTION	COMMENTS
57	OCEAN SHORES AP	NEW CONSTRUCTION
58	ODESSA MUNICIPAL AP	RECONSTRUCTED IN 1985,
59	ODESSA MUNICIPAL AP	
60	OKANAGAN LEGION AP	DBST ADDED IN 1987
61	OLYMPIA AP	
62	OLYMPIA AP	
63	OLYMPIA AP	
64	OTHELLO MUNICIPAL AP	
65	OMAK AP	
66	PACKWOOD AP	GRADED IN 1951, BST ADDED IN MID 1970'S
67	PANGBORN FIELD-WENATCHEE	
68	PANGBORN FIELD-WENATCHEE	
69	PANGBORN FIELD-WENATCHEE	
70	PANGBORN FIELD-WENATCHEE	
71	PEARSON AIRPARK	INFORMATION IS QUESTIONALABLE
72	PEARSON AIRPARK	
73	PIERCE COUNTY AP	
74	PORT OF ILWACO AP	AC AND BASE THICKNESS IS UNKNOWN,SURFACE CHECK=+1.5"
75	PORT OF WILLIPA HARBOR AP	
76	PORT OF WILLIPA HARBOR AP	
77	PROSSER AP	
78	PRU FIELD - RITZVILLE	
79	PULLMAN-MOSCOW REGIONAL AP	R/W GRO0VED AND CRACKFILLED IN 1985
80	PULLMAN-MOSCOW REGIONAL AP	
81	PULLMAN-MOSCOW REGIONAL AP	
82	QUILLAYUTE STATE	NEED TO KNOW WHEN THE R/W WAS CONSTRUCTED
83	QUINCY MUNICIPAL AP	RECIEVED A SS IN 1980 PCI=72
84	QUINCY MUNICIPAL AP	DID NOT RECIVE A SS IN 1980 AND IT'S PCI=31
85	RICHLAND AP	RECONSTRUCTED IN 1979
86	RICHLAND AP	RECONSTRUCTED IN 1979
87	RICHLAND AP	
88	ROSALIA MUNICIPAL AP	PAVEMENT IS IN POOR SHAPE FOR BEING SO NEW
89	SANDERSON FIELD,SHELTON	
90	SEKIU AP	
91	SEKIU AP	
92	SEQUIM VALLEY AP	
93	SKAGIT REGIONAL AP	
94	SKAGIT REGIONAL AP	
95	STORM FIELD, MORTON	
96	SUNNYSIDE MUNICIPAL AP	IN 1985 R/W WAS CRACKED SEALED AND MATERIAL SPRAYD ON
97	WALLA WALLA CITY COUNTY AP	
98	WALLA WALLA CITY COUNTY AP	
99	WALLA WALLA CITY COUNTY AP	
100	WATERVILLE AP	
101	WHITMAN COUNTY MEORIAL AP	ORIG. GRADED IN 1948
102	WILBUR AP	
103	WILLIAM R FAIRCHILD INT.AP	PFC ADDED IN 1980
104	WILLIAM R FAIRCHILD INT.AP	PFC ADDED IN 1980
105	WILLIAM R FAIRCHILD INT.AP	
106	WILLARD-TEKOA FIELD	WORHT INVESTIGATING (COULD BE THE SUBBASE)
107	WINLOCK AP	CRACKS SEALED IN 1957 (AC GOOD SHAPE FOR AGE)
108	WOODLAND STATE AP	BASE THICKNESS IS UNKNOWN

APPENDIX D

****

****

PAVEMENT CONDITION SURVEY DATA

FOR

OREGON

****

INCLUDING:

1) AIRPORT LOCATION AND DESCRIPTION

2) PAVEMENT IDENTIFICATION

3) ORIGINAL CONSTRUCTION DATE

4) ORIGINAL STRUCTURAL SECTION

5) AVERAGE PCI VALUE OF PAVEMENT FEATURE

6) DATE OF PAVEMENT CONDITION SURVEY

7) DESCRIPTION OF REPAIRS AND REHABILITATION

8) DATE OF REPAIRS OR REHABILITATION

9) DESCRIPTION OF THE EXISTING PAVEMENT FEATURE

10) COMMENTS PERTINENT TO EACH PAVEMENT FEATURE

[illegible]

NO.	AIRPORT LOCATION AND DESCRIPTION	PAVEMENT IDENT.	ORIGINAL CONSTRUCTION DATE	ORIGINAL STRUCTURAL SECTION	PCI AVE %	PCI DATE
1	ALBANY MUNICIPAL AP	R1	1959	2"AC,8"B	99	1988
2	ASHLAND MUNICIPAL AP	R1	1965	BST,4.5"B,3"SB	91	1987
3	ASHLAND MUNICIPAL AP	R2	1985	2"AC,8"B	92	1987
4	AURORA STATE AP	R1	?1975	3"AC,2"B,13"SB	85	1986
5	BAKER MUNICIPAL AP	R2	1942	2.5"AC,15"B	66	1986
6	BAKER MUNICIPAL AP	R3	1942	2.5"AC,15"B	69	1986
7	BAKER MUNICIPAL AP	R4	1983	2.5"AC,3"B,10"PRSB	88	1986
8	BAKER MUNICIPAL AP	R5	1983	2.5"AC,5"B,18"SB	90	1986
9	BANDON STATE AP	R1	1966	2.5"AC,?B	72	1986
10	BEND MUNICIPAL AP	R1	1977	2"AC,6"B	80	1986
11	BEND MUNICIPAL AP	R2	1977	2"AC,9"B	89	1986
12	BOARDMAN AP	R1	1943	2"AC,2"B,8"SB	57	1988
13	BROOKINGS STATE AP	R1	1968	2.5"AC,4"B	90	1986
14	BROOKINGS STATE AP	R2	1968	1.5"AC,4"B	90	1986
15	BURNS MUNICIPAL AP	R1	1942	2"AC,6"B,6"SB	50	1986
16	BURNS MUNICIPAL AP	R2	1942	2"AC,6"B,6"SB	49	1986
17	CHILOQUIN STATE AP	R1	1961	1.25"AC,4"B	25	1987
18	CHRISTMAS VALLEY AP	R1	1985	CS,3"AC,4"B,2"SB	90	1987
19	CONDON STATE AP	R1	1986	5"PCC,2"B	94	1987
20	CORVALLIS MUNICIPAL AP	R1	1942	2.5"AC,6"B,9"SB	93	1988
21	CORVALLIS MUNICIPAL AP	R2	1942	2"AC,6"B,10"SB	55	1988
22	COTTAGE GROVE STATE AP	R1	1966	1.5"AC,7"B	83	1988
23	COTTAGE GROVE STATE AP	R2	1970	1.5"AC,7"B	85	1988
24	COUNTY SQUIRE AIRPARK	R1	1976	2"AC,4-6"B	70	1988
25	CRESWELL MUNICIPAL AP	R1	1987	2"AC,4"B,12"SB	98	1988
26	FLORENCE MUNICIPAL AP	R1	1968	1.5"AC,6"B	95	1988
27	GOLD BEACH MUNICIPAL AP	R1	1964	1"AC,6"B	90	1986
28	HERMISTON MUNICIPAL AP	R1	1959	1.5"AC,3.5"B	80	1988
29	HERMISTON MUNICIPAL AP	R2	1977	3"AC,6"B	87	1988
30	HOOD RIVER AP	R1	1986	2"AC,9"B	96	1987
31	HOOD RIVER AP	R2	1986	2"AC,13"B	95	1987
32	HOOD RIVER AP	R3	1986	2"AC,6"B	91	1987
33	INDEPENDENCE STATE AP	R1	1974	2"AC,2"B,6"SB	91	1986
34	ILLINOIS VALLEY AP	R1	1953	BST,4"B,6"SB	87	1987
35	ILLINOIS VALLEY AP	R2	1960	3"AC,?B	93	1987
36	JOHN DAY STATE AP	R1	1962	2"AC,9"B	68	1986
37	JOHN DAY STATE AP	R3	1982	2"AC,4"B,9"B	93	1986
38	JOSPH STATE AP	R1	1966	1.5"AC,5"B	72	1986
39	LA GRANDE MUNICIPAL AP	R1	1942	2"AC,4"B,4.5"SB	51	1986
40	LA GRANDE MUNICIPAL AP	R2	1942	2"AC,4"B,4.5"SB	72	1986
41	LA GRANDE MUNICIPAL AP	R3	1974	2"AC,6"B,4.5"SB	88	1986
42	LAKE COUNTY AP	R1	1943	2"AC,11"B,4"SB	71	1987
43	LEXINGTON AP	R1	1965	DBST,4"B,6-10"SB AC	69	1987
44	LEBANON STATE AP	R1	UNK	2"AC,6"B	88	1988
45	LEBANON STATE AP	R2	1972	2"AC,6.5"B	89	1988
46	MADRAS CITY-COUNTY AP	R1	1943	2"AC,7.5"B,9"SB	84	1986
47	MADRAS CITY-COUNTY AP	R2	1943	2"AC,4"B,10"SB	16	1986
48	MADRAS CITY-COUNTY AP	R3	1943	9.5"PCC	46	1986
49	MADRAS CITY-COUNTY AP	R4	1943	3"AC,6"B,10"SB	39	1986
50	MC DERMITT STATE AP	R1	1985	2"AC,3"B,7"SB	96	1986
51	MC MINNVILLE MUNICIPAL AP	R1	1943	2"AC,6"B,8"SB	56	1988
52	MC MINNVILLE MUNICIPAL AP	R2	1943	2"AC,6"B,10"SB	61	1988
53	NEWHALAM BAY STATE AP	R1	1965	BST,6"B	80	1987
54	NORTH BEND MUNICIPAL AP	R1	1943	3"AC,6"B,4.5"SB	90	1988
55	NORTH BEND MUNICIPAL AP	R2	1943	2.5"AC,5.5"B,4.75"SB	88	1988
56	NORTH BEND MUNICIPAL AP	R2A	1943	2.24"AC,6.25"B,4"SB	90	1988

NO.	AIRPORT LOCATION AND DESCRIPTION	PAVEMENT IDENT.	ORIGINAL CONSTRUCTION DATE	ORIGINAL STRUCTURAL SECTION	PCI AVE. x	PCI DATE
57	NORTH BEND MUNICIPAL AP	R3	1943	3"AC,5.5"B,4"SB	75	1988
58	ONTARIO MUNICIPAL AP	R3	1978	2"AC,6"B,6"SB	84	1986
59	OREGON CITY AIRPARK	R1	1972	1"AC,?B	45	1988
60	PACIFIC CITY STATE AP	R1	1950	2"AC,4"B	79	1987
61	PINEHURST STATE AP	R1	1956	BST,?B	83	1987
62	PENDLETON MUNICIPAL AP	R1	1942	3"AC,7"B,6"SB	98	1988
63	PENDLETON MUNICIPAL AP	R2	1942	2"AC,,8"B	97	1988
64	PENDLETON MUNICIPAL AP	R3	1942	2"AC,8"B	82	1988
65	PENDLETON MUNICIPAL AP	R4	1942	2"AC,8"B	66	1988
66	PENDLETON MUNICIPAL AP	R5	1942	2"AC,5"B	87	1988
67	PENDLETON MUNICIPAL AP	R6	1942	2"AC,8"B	61	1988
68	PRINEVILLE AP	R1	UNK	2"AC,3"B,3.5"SB	87	1986
69	PRINEVILLE AP	R2	UNK	2"AC,6"B	86	1986
70	PRINEVILLE AP	R3	UNK	1"BST,6"B	39	1986
71	PORT OF ASTORIA AP	R1	1944	2.5"AC,13"B	87	1987
72	PORT OF ASTORIA AP	R1A	1944	9-6-9"PCC,9"SB	77	1987
73	PORT OF ASTORIA AP	R2	1944	2.5"AC,13"B	73	1987
74	ROBERTS FIELD,REDMOND AP	R1 (4-22)	1975	4"AC,7"B,17"SB	88	1986
75	ROBERTS FIELD,REDMOND AP	R1(10-28)	1975	4"AC,7"B,17"SB	91	1986
76	ROBERTS FIELD,REDMOND AP	R2	UK	3"AC,2"B,10"SB	92	1986
77	PROSPECT STATE AP	R1	1962	BST,6"B	54	1987
78	ROSEBURG MUNICIPAL AP	R1	1951	2"AC,6"B,6"SB	77	1987
79	SCAPPOOSE INDUSTRIAL AP	R1	1943	2"AC,6"B,12"SB	65	1987
80	SEASIDE STATE AP	R1	1964	1.75"AC,6"B	88	1987
81	SILETZ BAY STATE AP	R1	1971	1.5"AC,4.5"B,5"SB	80	1988
82	SPORTSMAN AIRPARK-NEWBERG	R1	1965	2"AC,4"B,10"SB	57	1986
83	NEWPORT MUNICIPAL AP	R1	1944	2"AC,6"B,9"SB	91	1988
84	NEWPORT MUNICIPAL AP	R2	1944	2"AC,6"B,9"SB	69	1988
85	NEWPORT MUNICIPAL AP	R3	1984	4'AC,6"B,5'SB	74	1988
86	SUNRIVER AP	R1	1970	DBST,14"CB	92	1986
87	SUTHERLIN MUNICIPAL AP	R1	1971	2"AC,12"B	90	1987
88	THE DALLES MUNICIPAL AP	R1	1943	2.25"AC,6.75"B	79	1988
89	THE DALLES MUNICIPAL AP	R2	1943	2.25"AC,6.75"B	79	1988
90	THE DALLES MUNICIPAL AP	R3	1943	2.25"AC,6.75"B	79	1988
91	TILLAMOOK AP	R1	1943	2'AC,6"B,10"SB	92	1987
92	TILLAMOOK AP	R2	1943	2'AC,6"B,10"SB	77	1987
93	TRI-CITY STATE AP	R1	1970	1.5"AC,6"B	88	1987
94	WASCO STATE AP	R1	1987	1"TBST,4"B,6"SB	87	1988

NO.	AIRPORT LOCATION AND DESCRIPTION	REPAIR/ REHAB. TYPE #1	R AND R #1 DATE	REPAIR/ REHAB. TYPE #2	R AND R #2 DATE	EXISTING PAVEMENT STRUCTURE
1	ALBANY MUNICIPAL AP	2"AC OL	1986			2"AC OL,2"AC,8"B
2	ASHLAND MUNICIPAL AP	2"AC OL	1977	1"AC OL	1986	2"OL,1"OL,4.5"B,3"SB
3	ASHLAND MUNICIPAL AP					2"AC,8"B
4	AURORA STATE AP	2"AC OL	1978			2"AC OL,3"AC,2"B,13"SB
5	BAKER MUNICIPAL AP	SC	1963			2.5"AC,15"B
6	BAKER MUNICIPAL AP	SC	1963			2.5"AC,15"B
7	BAKER MUNICIPAL AP	FS	1984			2.5"AC,3"B,10"PRSB
8	BAKER MUNICIPAL AP	FS	1984			2.5"AC,5"B,18"SB
9	BANDON STATE AP	CS	1972			CS,2.5"AC,?B
10	BEND MUNICIPAL AP					2"AC,6"B
11	BEND MUNICIPAL AP					2"AC,9"B
12	BOARDMAN AP	1.5"AC OL	1980			1.5"AC,2"AC,2"B,8"SB
13	BROOKINGS STATE AP					2.5"AC,4"B
14	BROOKINGS STATE AP					1.5"AC,4"B
15	BURNS MUNICIPAL AP	CS	1968	CS	1978	CS,CS,2"AC,6"B,6"SB
16	BURNS MUNICIPAL AP	CS	1968	CS	1978	CS,CS,2"AC,6"B,6"SB
17	CHILOQUIN STATE AP	SC	1968			SC,1.25"AC,4"B
18	CHRISTMAS VALLEY AP					CS,3"AC,4"B,2"SB
19	CONDON STATE AP					5"PCC,2"B
20	CORVALLIS MUNICIPAL AP	3"AC OL	1984			3"AC OL,2.5"AC,6"B,9"SB
21	CORVALLIS MUNICIPAL AP					2"AC,6"B,10"SB
22	COTTAGE GROVE STATE AP					1.5"AC,7"B
23	COTTAGE GROVE STATE AP					1.5"AC,7"B
24	COUNTY SQUIRE AIRPARK					2"AC,4-6"B
25	CRESWELL MUNICIPAL AP					2"AC,4"B,12"SB
26	FLORENCE MUNICIPAL AP	2"AC,6"B	1985			2"AC,6"B
27	GOLD BEACH MUNICIPAL AP	RESURF.	1983			1"AC,6"B
28	HERMISTON MUNICIPAL AP	2"AC OL	1977			2"AC OL,1.5"AC,3.5"B
29	HERMISTON MUNICIPAL AP					3"AC,6"B
30	HOOD RIVER AP					2"AC,9"B
31	HOOD RIVER AP					2"AC,13"B
32	HOOD RIVER AP					2"AC,6"B
33	INDEPENDENCE STATE AP	RECLAMITE	UNK			2"AC,2"B,6"SB
34	ILLINOIS VALLEY AP	SC	UNK	2"AC OL	1977	FS,2"AC OL,BST,4"B,6"SB
35	ILLINOIS VALLEY AP					3"AC,?B
36	JOHN DAY STATE AP	RECLAMITE	UNK			2"AC,9"B
37	JOHN DAY STATE AP					2"AC,4"B,9"B
38	JOSPH STATE AP					1.5"AC,5"B
39	LA GRANDE MUNICIPAL AP					2"AC,4"B,4.5"SB
40	LA GRANDE MUNICIPAL AP	4"AC OL	1974			4"AC OL,2"AC,4"B,4.5"SB
41	LA GRANDE MUNICIPAL AP					2"AC,6"B,4.5"SB
42	LAKE COUNTY AP	1.75"ACOL	1974	SS	1985	SS,1.75"AC OL,2"AC,11"B,4"SB
43	LEXINGTON AP					DBST,4"B,6-10"SB AC
44	LEBANON STATE AP	1.5"AC OL	UNK			1.5"OL,2"AC,6"B
45	LEBANON STATE AP					2"AC,6.5"B
46	MADRAS CITY-COUNTY AP	1"AC OL	1961	1"AC OL	1977	2"AC OL,2"AC,7.5"B,9"SB
47	MADRAS CITY-COUNTY AP					2"AC,4"B,10"SB
48	MADRAS CITY-COUNTY AP					9.5"PCC
49	MADRAS CITY-COUNTY AP					3"AC,6"B,10"SB
50	MC DERMITT STATE AP					2"AC,3"B,7"SB
51	MC MINNVILLE MUNI. AP					2"AC,6"B,8"SB
52	MC MINNVILLE MUNI. AP	SS	1980			SS,2"AC,6"B,10"SB
53	NEWHALAM BAY STATE AP	DBST	1979			TBST,6'B
54	NORTH BEND MUNICIPAL AP	CS	1952	2"AC OL	1977	2"AC OL,CS,3"AC,6"B,4.5"SB
55	NORTH BEND MUNICIPAL AP	CS	1952	2"AC OL	1977	2"ACOL,CS,2.5"AC,5.5"B,4.75"SB
56	NORTH BEND MUNICIPAL AP	CS	1952	2"AC OL	1977	2"ACOL,CS,2.24"AC,6.25"B,4"SB

NO.	AIRPORT LOCATION AND DESCRIPTION	REPAIR/ REHAB. TYPE #1	R AND R #1 DATE	REPAIR/ REHAB. TYPE #2	R AND R #2 DATE	EXISTING PAVEMENT STRUCTURE
57	NORTH BEND MUNICIPAL AP	CS	1952			CS,3"AC,5.5"B,4"SB
58	ONTARIO MUNICIPAL AP					2"AC,6"B,6"SB
59	OREGON CITY AIRPARK					1"AC,?B
60	PACIFIC CITY STATE AP					2"AC,4"B
61	PINEHURST STATE AP	1"AC OL	1985			1"AC OL,BST,?B
62	PENDLETON MUNICIPAL AP	3.5"AC OL	1962	3.5"ACOL	1974	PFC,7"AC OL,3"AC,7"B,6"SB
63	PENDLETON MUNICIPAL AP	3.5"AC OL	1962	3.5"ACOL	1974	PFC,7"AC OL,2"AC,8"B
64	PENDLETON MUNICIPAL AP	3"AC OL	1978			3"AC OL,2"AC,8"B
65	PENDLETON MUNICIPAL AP	5.5"AC OL	1978			5.5"AC OL,2"AC,8"B
66	PENDLETON MUNICIPAL AP	10"AC OL	1978			10"AC OL,2"AC,5"B
67	PENDLETON MUNICIPAL AP					CS,2"AC,8"B
68	PRINEVILLE AP					2"AC,3"B,3.5"SB
69	PRINEVILLE AP					2"AC,6"B
70	PRINEVILLE AP					1"BST,6"B
71	PORT OF ASTORIA AP	.75"AC OL	1980			.75"AC OL,2.5"AC,13"B
72	PORT OF ASTORIA AP	.75"AC OL	1980			.75"AC OL,9"-6"-9"PCC,9"SB
73	PORT OF ASTORIA AP					2.5"AC,13"B
74	ROBERTS FIELD,REDMOND AP	PFC	1981			PFC,4"AC,7"B,17"SB
75	ROBERTS FIELD,REDMOND AP					4"AC,7"B,17"SB
76	ROBERTS FIELD,REDMOND AP					3"AC,2"B,10"SB
77	PROSPECT STATE AP	CS	1970	BST	1986	DBST,6"B
78	ROSEBURG MUNICIPAL AP	SS	1986			SS,2"AC,6"B6,"SB
79	SCAPPOOSE INDUSTRIAL AP	SS	1986			SS,2"AC,6"B,12"SB
80	SEASIDE STATE AP					1.75"AC,6"B
81	SILETZ BAY STATE AP					1.5"AC,4.5"B,5"SB
82	SPORTSMAN AIRPARK-NEWBERG					2"AC,4"B,10"SB
83	NEWPORT MUNICIPAL AP	3"AC OL	1984			3"AC OL,2"AC,6"B,9"SB
84	NEWPORT MUNICIPAL AP	SS	1984			SS,2"AC,6"B,9"SB
85	NEWPORT MUNICIPAL AP					4"AC,6"B,5"SB
86	SUNRIVER AP	SC/SS	1973/82	2"AC OL	1985	SC,SS,2"AC OL,DBST,14"CB
87	SUTHERLIN MUNICIPAL AP					2"AC,12"B
88	THE DALLES MUNICIPAL AP	SS	1965			SS,2.25"AC,6.75"B
89	THE DALLES MUNICIPAL AP					2.25"AC,6.75"B
90	THE DALLES MUNICIPAL AP					2.25"AC,6.75"B
91	TILLAMOOK AP	1.5"AC OL	1983			1.5"AC OL,2"AC,6"B,10"SB
92	TILLAMOOK AP	CS	1983			CS,2"AC,6"B,10"SB
93	TRI-CITY STATE AP	CS	UNK			CS,1.5"AC,6"B
94	WASCO STATE AP					1"TBST,4"B,6"SB

NO. AIRPORT LOCATION AND DESCRIPTION	COMMENTS
1 ALBANY MUNICIPAL AP	
2 ASHLAND MUNICIPAL AP	
3 ASHLAND MUNICIPAL AP	
4 AURORA STATE AP	THE 1978 OL USED A HEATER SCARIFIER PROCESS
5 BAKER MUNICIPAL AP	
6 BAKER MUNICIPAL AP	
7 BAKER MUNICIPAL AP	2.5"AC,3"P201 B,10"PIT RUN SUBBASE
8 BAKER MUNICIPAL AP	2.5"AC,3"P201 B,2"CA B,18"P154 SUBBASE
9 BANDON STATE AP	ORIGINALLY A GRAVEL LANDING STRIP
10 BEND MUNICIPAL AP	
11 BEND MUNICIPAL AP	NOTE THE DIFFERENCE IN THE EXTRA BASE IN R/W R1
12 BOARDMAN AP	
13 BROOKINGS STATE AP	
14 BROOKINGS STATE AP	
15 BURNS MUNICIPAL AP	
16 BURNS MUNICIPAL AP	
17 CHILOQUIN STATE AP	
18 CHRISTMAS VALLEY AP	CS,3"COLD MIX AC,4"STABILIZED B,2"GRAVEL SB
19 CONDON STATE AP	ORIG. 1"AC,8"B (1966)
20 CORVALLIS MUNICIPAL AP	
21 CORVALLIS MUNICIPAL AP	
22 COTTAGE GROVE STATE AP	PAVEMENT IS IN EXCELLENT CONDITION
23 COTTAGE GROVE STATE AP	
24 COUNTY SQUIRE AIRPARK	
25 CRESWELL MUNICIPAL AP	
26 FLORENCE MUNICIPAL AP	R/W RECONSTRUCTED IN 1985
27 GOLD BEACH MUNICIPAL AP	R/W RESURFACED 1983 MATERIAL UK (AC IN GOOD SHAPE)
28 HERMISTON MUNICIPAL AP	
29 HERMISTON MUNICIPAL AP	
30 HOOD RIVER AP	ORIG.1948, IMPROVEMENTS 1970, RESURFACED 1986 (?)
31 HOOD RIVER AP	
32 HOOD RIVER AP	
33 INDEPENDENCE STATE AP	GOOD CONDITION CONSIDERING AGE
34 ILLINOIS VALLEY AP	FOG SEAL ADDED IN 1980
35 ILLINOIS VALLEY AP	
36 JOHN DAY STATE AP	COLD AC PAVEMENT
37 JOHN DAY STATE AP	
38 JOSPH STATE AP	
39 LA GRANDE MUNICIPAL AP	
40 LA GRANDE MUNICIPAL AP	
41 LA GRANDE MUNICIPAL AP	
42 LAKE COUNTY AP	
43 LEXINGTON AP	
44 LEBANON STATE AP	INFORMATION IS VAGUE
45 LEBANON STATE AP	
46 MADRAS CITY-COUNTY AP	
47 MADRAS CITY-COUNTY AP	
48 MADRAS CITY-COUNTY AP	
49 MADRAS CITY-COUNTY AP	
50 MC DERMITT STATE AP	FOG SEAL, BASE=CRUSHED AGGREGATE, SB=PIT RUN BASE
51 MC MINNVILLE MUNICIPAL AP	
52 MC MINNVILLE MUNICIPAL AP	
53 NEWHALAM BAY STATE AP	
54 NORTH BEND MUNICIPAL AP	
55 NORTH BEND MUNICIPAL AP	
56 NORTH BEND MUNICIPAL AP	

NO. AIRPORT LOCATION AND DESCRIPTION	COMMENTS
57 NORTH BEND MUNICIPAL AP	
58 ONTARIO MUNICIPAL AP	RECONSTRUCTED LATE 1970'S, ORIG. CONSTRUTION 1943
59 OREGON CITY AIRPARK	
60 PACIFIC CITY STATE AP	
61 PINEHURST STATE AP	
62 PENDLETON MUNICIPAL AP	PFC ADDED IN 1982 (NEED MORE INFO)
63 PENDLETON MUNICIPAL AP	PFC ADDED IN 1982 (NEED MORE INFO)
64 PENDLETON MUNICIPAL AP	
65 PENDLETON MUNICIPAL AP	
66 PENDLETON MUNICIPAL AP	
67 PENDLETON MUNICIPAL AP	
68 PRINEVILLE AP	INFORMATION ON THIS AIRPORT IS VERY VAGUE
69 PRINEVILLE AP	
70 PRINEVILLE AP	
71 PORT OF ASTORIA AP	
72 PORT OF ASTORIA AP	
73 PORT OF ASTORIA AP	
74 ROBERTS FIELD,REDMOND AP	PETRO-MAT WAS PLACED ON RUNWAY 4-22 PRIOR TO THE PFC
75 ROBERTS FIELD,REDMOND AP	
76 ROBERTS FIELD,REDMOND AP	
77 PROSPECT STATE AP	
78 ROSEBURG MUNICIPAL AP	
79 SCAPPOOSE INDUSTRIAL AP	R/W IN GOOD SHAPE CONSIDERING THE AGE AND MAINTENANCE
80 SEASIDE STATE AP	CRACK FILLING IN 1986
81 SILETZ BAY STATE AP	CRACKFILLING
82 SPORTSMAN AIRPARK-NEWBERG	CRACKFILLING 1982
83 NEWPORT MUNICIPAL AP	
84 NEWPORT MUNICIPAL AP	
85 NEWPORT MUNICIPAL AP	
86 SUNRIVER AP	2"AC OVERLAY ADDED IN 1985
87 SUTHERLIN MUNICIPAL AP	
88 THE DALLES MUNICIPAL AP	
89 THE DALLES MUNICIPAL AP	
90 THE DALLES MUNICIPAL AP	
91 TILLAMOOK AP	
92 TILLAMOOK AP	
93 TRI-CITY STATE AP	
94 WASCO STATE AP	

APPENDIX E

****

****

PAVEMENT CONDITION SURVEY DATA

FOR

IDAHO

****

INCLUDING:

1) AIRPORT LOCATION AND DESCRIPTION
2) PAVEMENT IDENTIFICATION
3) ORIGINAL CONSTRUCTION DATE
4) ORIGINAL STRUCTURAL SECTION
5) AVERAGE PCI VALUE OF PAVEMENT FEATURE
6) DATE OF PAVEMENT CONDITION SURVEY
7) DESCRIPTION OF REPAIRS AND REHABILITATION
8) DATE OF REPAIRS OR REHABILITATION
9) DESCRIPTION OF THE EXISTING PAVEMENT FEATURE
10) COMMENTS PERTINENT TO EACH PAVEMENT FEATURE

NO.	AIRPORT LOCATION AND DESCRIPTION	PAVEMENT IDENT.	ORIGINAL CONSTRUCTION DATE	ORIGINAL STRUCTURAL SECTION	PCI AVE %	PCI DATE
1	ARCO (BUTTE COUNTY) AP	R1	1979	2"AC,4"B,6"SB	66	1986
2	BEAR LAKE COUNTY AP	R1	UNK	2"AC,6"B,10"SB	27	1986
3	BEAR LAKE COUNTY AP	R2	1984	2"AC,2"B,4"SB	96	1986
4	BUHL MUNICIPAL AP	R1	1983	2"AC,4"B,6"SB	69	1986
5	BURLEY MUNICIPAL AP	R1	UNK	2.5"AC,12"B	67	1986
6	BURLEY MUNICIPAL AP	R2	UNK	2.5"AC,10"B	56	1986
7	CALDWELL AP	R1	1975	2"AC,4"B,5"SB,7"FC	94	1986
8	CALDWELL AP	R2	1975	2"AC,4"B,5"SB,7"FC	100	1986
9	CHALLIS AP	R1	1973	BST,6"B	79	1986
10	COEUR D'ALENE AIR TERMINAL	R1	UNK	2"AC,6"B	77	1986
11	COEUR D'ALENE AIR TERMINAL	R2	UNK	2"AC,6"B	79	1986
12	COEUR D'ALENE AIR TERMINAL	R3	UNK	2"AC,6"B	79	1986
13	COEUR D'ALENE AIR TERMINAL	R4	UNK	3"AC,8"B	89	1986
14	CRAIGMONT MUNICIPAL AP	R1	1975	1"AC,5"B,10"SB	57	1986
15	DRIGGS MUNICIPAL AP	R1	1975	2"AC,4"B,6"SB	81	1986
16	GOODING MUNICIPAL AP	R1	1978	2"AC,8"B	86	1986
17	GRANGEVILLE (IDAHO CO.) AP	R1	1965	3"AC,12"B,12"SB	71	1986
18	GRANGEVILLE (IDAHO CO.) AP	R2	1983	4"AC,18"B	73	1986
19	GRANGEVILLE (IDAHO CO.) AP	R3	1983	4"AC,18"B	73	1986
20	JEROME COUNTY AP	R1	UNK	7.5"AC,3.5"B	65	1986
21	JEROME COUNTY AP	R2	1981	2"AC,4"B,6"SB	90	1986
22	KELLOGG (SHOSHONE CO.) AP	R1	UNK	1"AC,4"B,24"SB	94	1986
23	KELLOGG (SHOSHONE CO.) AP	R2	UNK	1"AC,5"B,24"SB	94	1986
24	KELLOGG (SHOSHONE CO.) AP	R3	UNK	1.5"AC,5"SB	40	1986
25	KELLOGG (SHOSHONE CO.) AP	R4	UNK	1"AC,5"B,24"SB	96	1986
26	KELLOGG (SHOSHONE CO.) AP	R5	UNK	1"AC,4"B,24"SB	93	1986
27	MC CALL MUNICIPAL AP	R1	1974	3"AC,6"B	87	1986
28	MOUNTAIN HOME MUNICIPAL AP	R1	1973	2"AC,7.5"B,8"SB	70	1986
29	NAMPA MUNICIPAL AP	R1	1976	2"AC,3"B,8"SB	91	1986
30	OROFINO MUNICIPAL AP	R1	1969	2"AC,4"B,4"SB	81	1986
31	PRIEST RIVER MUNICIPAL AP	R1	1975	2.5"AC,6"B	86	1986
32	REXBURG (MADISON CO.) AP	R1	1972	2"AC,6"B,6"SB	63	1986
33	REXBURG (MADISON CO.) AP	R3	1977	2.5"AC,6"B,6"SB	71	1986
34	REXBURG (MADISON CO.) AP	R4	1977	2.5"AC,8"B,12"SB	61	1986
35	ST. MARIES MUNICIPAL AP	R1	1978	1.5"AC,11"B,NWF	59	1986
36	SANDPOINT AP	R1	1952	BST,6"B,6"SB	24	1986
37	SANDPOINT AP	R2	UNK	2"AC,?B,?SB	45	1986
38	SODA SPRINGS AP	R1	1969	2.5"AC,?B,?SB	42	1986

NO.	AIRPORT LOCATION AND DESCRIPTION	REPAIR/ REHAB. TYPE #1	R AND R #1 DATE	REPAIR/ REHAB. TYPE #2	R AND R #2 DATE	EXISTING PAVEMENT STRUCTURE
1	ARCO (BUTTE COUNTY) AP					2"AC,4"B,6"SB
2	BEAR LAKE COUNTY AP	FS	UNK			2"AC,6"B,10"SB
3	BEAR LAKE COUNTY AP					2"AC,2"B,4"SB
4	BUHL MUNICIPAL AP					2"AC,4"B,6"SB
5	BURLEY MUNICIPAL AP	2"AC OL	1972	SS	1980	SC,2"AC OL,2.5"AC,12"B
6	BURLEY MUNICIPAL AP	?OL	UNK			SC,?OL,2.5"AC,10"B
7	CALDWELL AP	FS	1984	SS	1986	SS,FS,2"AC,4"B,5"SB,7"FC
8	CALDWELL AP	FS	1984	SS	1986	SS,FS,2"AC,4"B,5"SB,7"FC
9	CHALLIS AP	2"AC OL	1974	FS	1977/86	FS,2"AC OL,BST,6"B
10	COEUR D'ALENE AIR TERMINAL	3"AC OL	UNK	SS	1973	SS,3"AC OL,2"AC,6"B
11	COEUR D'ALENE AIR TERMINAL	3"AC OL	UNK	SS	1973	SS,3"AC OL,2"AC,6"B
12	COEUR D'ALENE AIR TERMINAL	3"AC OL	UNK	SS	1973	SS,3"AC OL,2"AC,6"B
13	COEUR D'ALENE AIR TERMINAL			SS	1973	SS,3"AC,8"B
14	CRAIGMONT MUNICIPAL AP	FS	1978	CS	1983	CS,FS,1"AC,5"B,10"SB
15	DRIGGS MUNICIPAL AP					2"AC,4"B,6"SB
16	GOODING MUNICIPAL AP	SS	1985			SS,2"AC,8"B
17	GRANGEVILLE (IDAHO CO.) AP	2"AC OL	1983			2"AC OL,3"AC,12"B,12"SB
18	GRANGEVILLE (IDAHO CO.) AP					4"AC,18"B
19	GRANGEVILLE (IDAHO CO.) AP					4"AC,18"B
20	JEROME COUNTY AP	FS	1972	CS	1975	CS,FS,7.5"AC,3.5"B
21	JEROME COUNTY AP					2"AC,4"B,6"SB
22	KELLOGG (SHOSHONE CO.) AP	1"AC OL	1980			1"AC OL,1"AC,4"B,24"SB
23	KELLOGG (SHOSHONE CO.) AP	1"AC OL	1980			1"AC OL,1"AC,5"B,24"SB
24	KELLOGG (SHOSHONE CO.) AP	SS	1983			SS,1.5"AC,5"B
25	KELLOGG (SHOSHONE CO.) AP	3"AC OL	1980			3"AC OL,1"AC,5"B,24"SB
26	KELLOGG (SHOSHONE CO.) AP	3"AC OL	1980			3"AC OL,1"AC,4"B,24"SB
27	MC CALL MUNICIPAL AP	SS	1985			SS,3"AC,6"B
28	MOUNTAIN HOME MUNICIPAL AP					2"AC,7.5"B,8"SB
29	NAMPA MUNICIPAL AP	FS	1982	SS	1985	SS,FS,2"AC,3"B,8"SB
30	OROFINO MUNICIPAL AP	SS	UNK			SS,2"AC,4"B,4"SB
31	PRIEST RIVER MUNICIPAL AP	SS	UNK			SS,2.5"AC,6"B
32	REXBURG (MADISON CO.) AP	SS	UNK			SS,2"AC,6"B,6"SB
33	REXBURG (MADISON CO.) AP	SS	UNK			SS,2.5"AC,6"B,6"SB
34	REXBURG (MADISON CO.) AP	SS	UNK			SS,2.5"AC,8"B,12"SB
35	ST. MARIES MUNICIPAL AP					1.5"AC,11"B,NWF
36	SANDPOINT AP	BST	UNK			DBST,6"B6"SB
37	SANDPOINT AP					2"AC,?B,?SB
38	SODA SPRINGS AP	SS	1983			2.5"AC,?B,?SB

NO.	AIRPORT LOCATION AND DESCRIPTION	COMMENTS
1	ARCO (BUTTE COUNTY) AP	CRACK SEALING IN 1982
2	BEAR LAKE COUNTY AP	INFORMATION IS VAGUE
3	BEAR LAKE COUNTY AP	
4	BUHL MUNICIPAL AP	
5	BURLEY MUNICIPAL AP	INFORMATION IS VAGUE, CRACK SEAL 1980 AND 1986
6	BURLEY MUNICIPAL AP	INFORMATION IS VAGUE, CRACK SEAL 1980 AND 1986
7	CALDWELL AP	CRACK SEALING IN 1973 , 1983 AND YEARLY SINCE
8	CALDWELL AP	CRACK SEALING IN 1973 , 1983 AND YEARLY SINCE
9	CHALLIS AP	CRACK SEALING IN 1973 , 1983 AND YEARLY SINCE
10	COEUR D'ALENE AIR TERMINAL	CRACK SEALING IN 1973 , 1983 AND YEARLY SINCE
11	COEUR D'ALENE AIR TERMINAL	
12	COEUR D'ALENE AIR TERMINAL	
13	COEUR D'ALENE AIR TERMINAL	
14	CRAIGMONT MUNICIPAL AP	
15	DRIGGS MUNICIPAL AP	
16	GOODING MUNICIPAL AP	
17	GRANGEVILLE (IDAHO CO.) AP	CRACK SEALING IN 1981
18	GRANGEVILLE (IDAHO CO.) AP	
19	GRANGEVILLE (IDAHO CO.) AP	
20	JEROME COUNTY AP	
21	JEROME COUNTY AP	
22	KELLOGG (SHOSHONE CO.) AP	
23	KELLOGG (SHOSHONE CO.) AP	
24	KELLOGG (SHOSHONE CO.) AP	
25	KELLOGG (SHOSHONE CO.) AP	
26	KELLOGG (SHOSHONE CO.) AP	
27	MC CALL MUNICIPAL AP	CRACK SEALING IN 1985
28	MOUNTAIN HOME MUNICIPAL AP	CRACK SEALING IN 1979 AND 1984
29	NAMPA MUNICIPAL AP	
30	OROFINO MUNICIPAL AP	
31	PRIEST RIVER MUNICIPAL AP	
32	REXBURG (MADISON CO.) AP	
33	REXBURG (MADISON CO.) AP	
34	REXBURG (MADISON CO.) AP	
35	ST. MARIES MUNICIPAL AP	CRACK SEALING IN 1984
36	SANDPOINT AP	CRACK SEALING IN 1981
37	SANDPOINT AP	CRACK SEALING IN 1981
38	SODA SPRINGS AP	CRACK SEALING IN 1983

APPENDIX F

****
****

MINITAB CALCULATIONS
USED IN THE ANALYSIS

FLEXIBLE PAVEMENT
EXAMPLE

<u>Two to three inches of AC on six to eight inches of base</u>

DATA INCLUDED:

1...Print out of data points by state.

(a) WASHINGTON PCI-W and AGE-W
(b) OREGON PCI-O and AGE-O
(c) IDAHO PCI-I and AGE-I
(d) COMBINED PCI and AGE
(e) With assumption of AGE = 0 and PCI = 100.
(b) Without assumption.

2...Regression analysis of each state's data.

(a) With assumption of AGE = 0 and PCI = 100.
(b) Without assumption.

3...Plot of the each state's data.

(a) With assumption of AGE = 0 and PCI = 100.
(b) Without assumption.

4...Regression analysis of each state's data using a log vs log analysis.

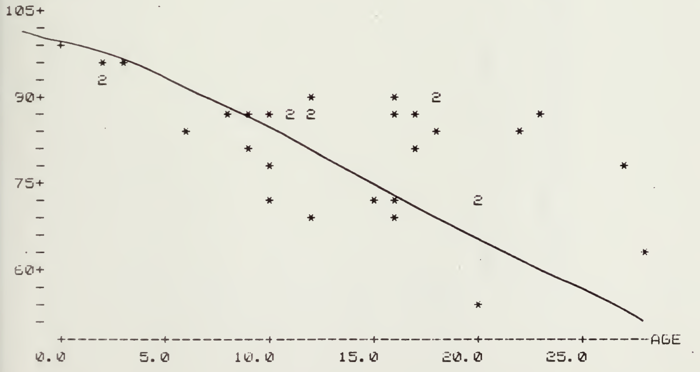
```
> INFO C1 C2 C3 C4 C5 C6 C7 C8

JMN      NAME        COUNT
         AGE-W          26
         PCI-W          26
         AGE-O          32
         PCI-O          32
         AGE-I          10
         PCI-I          10
         AGE            68
         PCI            68



> PRINT C1 C2 C3 C4 C5 C6
J  AGE-W   PCI-W   AGE-O   PCI-O   AGE-I   PCI-I

1      0     100       0     100       0     100
2      0     100       0     100       0     100
3      0     100       0     100       0     100
4      0     100       0     100       0     100
5      0     100       0     100       0     100
6      0     100       0     100       2      96
7      0     100       0     100       8      86
8      0     100       0     100      12      87
9      0     100       0     100      17      81
0      0     100       0     100      11      86
1      0     100       0     100
2      0     100       0     100
3      0     100       0     100
4     16      72       0     100
5     10      72       0     100
6     12      88       0     100
7     20      55       2      92
8     16      86      20      72
9      6      84       9      80
0      2      93      18      90
1     10      77      18      90
2     15      71      22      83
3     28      64      18      85
4     10      88      12      70
5     16      68       3      95
6      9      88      11      87
7                     12      91
8                     20      72
9                     16      89
0                     27      79
1                     23      88
2                     17      88
```

```
 > REGRESS C2 1 C1

 regression equation is
-W = 99.1 - 1.59 AGE-W

dictor        Coef          Stdev     t-ratio
stant       99.106          1.427       69.43
-W         -1.5926         0.1390      -11.46

 5.613        R-sq = 84.5%     R-sq(adj) = 83.9%

lysis of Variance

RCE         DF           SS            MS
ression      1       4135.5        4135.5
or          24        756.0          31.5
al          25       4891.5

sual Observations
.    AGE-W      PCI-W        Fit  Stdev.Fit   Residual    St.Resid
      10.0      72.00      83.18       1.20     -11.18      -2.04R
      20.0      55.00      67.25       2.17     -12.25      -2.37R
      16.0      86.00      73.62       1.71      12.38       2.32R
      28.0      64.00      54.51       3.18       9.49       2.05RX

enotes an obs. with a large st. resid.
enotes an obs. whose X value gives it large influence.


 > PLOT C2 VS C1

  105+
     -
-W   - +
     -
     -   *
   90+
     -           *  *   *       *
     -       *
     -
     -              *
   75+
     -              *         * *
     -                          *
     -
     -                                              *
   60+
     -
     -                                 *
     -
       +---------+---------+---------+---------+---------+------AGE-W
     0.0       5.0      10.0      15.0      20.0      25.0
```

```
) REGRESS C4 1 C3

 regression equation is
-O = 98.8 - 0.848 AGE-O

dictor          Coef           Stdev      t-ratio
stant         98.792           1.297        76.19
-O           -0.8482          0.1086        -7.81

 5.580         R-sq = 67.0%      R-sq(adj) = 65.9%

lysis of Variance

RCE          DF            SS             MS
ression       1        1899.3         1899.3
or           30         934.1           31.1
al           31        2833.5

sual Observations
.    AGE-O      PCI-O         Fit  Stdev.Fit   Residual    St.Resid
       9.0     80.000      91.159      0.996    -11.159      -2.03R
      12.0     70.000      88.614      1.089    -18.614      -3.40R

enotes an obs. with a large st. resid.


)
) PLOT C4 VS C3

     -
  100+ +
     -
-O   -       *
     -
     -    *                   *
   90+                                 *   2
     -                       *           *           *
     -                                   *
     -                                         *
     -
   80+                   *                                   *
     -
     -
     -
     -                                     2
   70+                        *
     -
     -
       +---------+---------+---------+---------+---------+------AGE-O
     0.0       5.0      10.0      15.0      20.0      25.0
```

```
 > REGRESS C6 1 C5

 regression equation is
-I = 99.4 - 1.16 AGE-I

dictor        Coef          Stdev     t-ratio
stant      99.4199         0.7141      139.23
-I        -1.16398        0.09054      -12.86

 1.746       R-sq = 95.4%     R-sq(adj) = 94.8%

lysis of Variance

RCE         DF          SS            MS
ression      1      504.00        504.00
or           8       24.40          3.05
al           9      528.40

sual Observations
.    AGE-I      PCI-I       Fit  Stdev.Fit   Residual    St.Resid
       8.0     86.000    90.108      0.615     -4.108      -2.51R

enotes an obs. with a large st. resid.
 > PLOT C6 VS C5

    -
-I  - 5
    -
    -
96.0+       *
    -
    -
    -
    -
90.0+
    -
    -                                   *
    -                        *       *
    -
84.0+
    -
    -                                              *
    -
    -
      +---------+---------+---------+---------+---------+------AGE-I
    0.0       3.5       7.0      10.5      14.0      17.5
```

```
) REGRESS C8 1 C7

regression equation is
= 98.8 - 1.12 AGE

dictor        Coef           Stdev     t-ratio
stant       98.7726          0.9914       99.63
           -1.11867         0.09183      -12.18  - (t2 )

6.299         R-sq = 69.2%      R-sq(adj) = 68.8%

lysis of Variance

RCE         DF            SS             MS
ression      1        5888.0         5888.0
or          66        2618.6           39.7
al          67        8506.6

sual Observations
      AGE         PCI          Fit  Stdev.Fit   Residual     St.Resid
     10.0      72.000       87.586      0.816    -15.586      -2.50R
     20.0      55.000       76.399      1.426    -21.399      -3.49R
     28.0      64.000       67.450      2.084     -3.450      -0.58 X
     16.0      68.000       80.874      1.133    -12.874      -2.08R
     12.0      70.000       85.349      0.897    -15.349      -2.46R
     27.0      79.000       68.569      1.999     10.431       1.75 X
     23.0      88.000       73.043      1.666     14.957       2.46R

enotes an obs. with a large st. resid.
enotes an obs. whose X value gives it large influence.

) PLOT C8 VS C7
```



) INFO C1 C2 C3 C4 C5 C6 C7 C8

JMN	NAME	COUNT
	AGE-W	13
	PCI-W	13
	AGE-O	16
	PCI-O	16
	AGE-I	5
	PCI-I	5
	AGE	34
	PCI	34

) PRINT C1 C2 C3 C4 C5 C6 C7 C8

W	AGE-W	PCI-W	AGE-O	PCI-O	AGE-I	PCI-I	AGE	PCI
1	16	72	2	92	2	96	16	72
2	10	72	20	72	8	86	2	92
3	12	88	9	80	12	87	10	72
4	20	55	18	90	17	81	12	88
5	16	86	18	90	11	86	20	55
6	6	84	22	83			16	86
7	2	93	18	85			6	84
8	10	77	12	70			10	77
9	15	71	3	95			28	64
0	28	64	11	87			16	68
1	10	88	12	91			9	88
2	16	68	20	72			20	72
3	9	88	16	89			9	80
4			27	79			18	90
5			23	88			18	90
6			17	88			22	83
7							18	85
8							12	70
9							3	95
0							11	87
1							12	91
2							20	72
3							16	89
4							27	79
5							23	88
6							17	88
7							2	96
8							8	86
9							12	87
0							17	81
1							11	86
2							2	93
3							15	71
4							10	88

```
 ) REGRESS C2 1 C1

 regression equation is
-W = 94.4 - 1.30 AGE-W

dictor        Coef          Stdev     t-ratio
stant       94.379          5.052       18.68
-W         -1.2996         0.3478       -3.74

 7.924        R-sq = 55.9%     R-sq(adj) = 51.9%

lysis of Variance

RCE         DF           SS            MS
ression      1       876.42        876.42
or          11       690.66         62.79
al          12      1567.08

sual Observations
.   AGE-W      PCI-W         Fit  Stdev.Fit   Residual    St.Resid
     28.0      64.00       57.99       5.64       6.01       1.08 X

enotes an obs. whose X value gives it large influence.



 ) PLOT C2 VS C1

     -   *
-W   -
     -                 *  *   *
     -                               *
   84+           *
     -
     -
     -                   *
     -
   72+                   *         *   *
     -
     -                               *
     -                                                       *
     -
   60+
     -
     -                                       *
     -
     -
      ---------+---------+---------+---------+---------+--------AGE-W
             5.0      10.0      15.0      20.0      25.0
```

```
 > REGRESS C4 1 C3

 regression equation is
-O = 91.1 - 0.431 AGE-O

dictor         Coef          Stdev     t-ratio
stant        91.119          4.651       19.59
-O          -0.4311         0.2754       -1.57

 7.380       R-sq = 14.9%      R-sq(adj) = 8.8%

lysis of Variance

RCE         DF           SS           MS
ression      1       133.41       133.41
or          14       762.52        54.47
al          15       895.94

sual Observations
.    AGE-O     PCI-O       Fit  Stdev.Fit  Residual   St.Resid
      12.0     70.00     85.95       2.08    -15.95     -2.25R

enotes an obs. with a large st. resid.



 > PLOT C4 VS C3

-O   -       *
     -
     -     *
 91.0+                         *
     -                                 *   2
     -                                   *           *
     -                       *
     -                                     *
 84.0+
     -                                             *
     -
     -                   *
     -                                                       *
 77.0+
     -
     -
     -
     -                                         2
 70.0+                         *
       +---------+---------+---------+---------+---------+------AGE-O
     0.0       5.0      10.0      15.0      20.0      25.0
```

```
) REGRESS C6 1 C5

regression equation is
-I = 96.5 - 0.926 AGE-I

dictor        Coef          Stdev     t-ratio
stant       96.462          2.192       44.01
-I         -0.9262         0.1965       -4.71

2.171        R-sq = 88.1%     R-sq(adj) = 84.1%

lysis of Variance

RCE          DF           SS           MS
ression       1       104.66       104.66
or            3        14.14         4.71
al            4       118.80
```

```
) PLOT C6 VS C5

         -
         -     *
    95.0+
         -
-I       -
         -
         -
    90.0+
         -
         -
         -                                 *
         -                   *         *
    85.0+
         -
         -
         -
         -                                                   *
    80.0+
         -
          ------+---------+---------+---------+---------+---------+AGE-I
              3.0       6.0       9.0      12.0      15.0      18.0
```

```
) REGRESS C8 1 C7

regression equation is
= 92.2 - 0.732 AGE

dictor          Coef           Stdev     t-ratio
stant         92.218           3.356       27.48
             -0.7316          0.2198       -3.33

8.467         R-sq = 25.7%       R-sq(adj) = 23.4%

lysis of Variance

RCE         DF            SS            MS
ression      1        794.42        794.42
or          32       2293.84         71.68
al          33       3088.26

sual Observations
.     AGE       PCI         Fit Stdev.Fit   Residual    St.Resid
     20.0     55.00       77.59      2.00     -22.59      -2.74R

enotes an obs. with a large st. resid.


) PLOT C8 VS C7

   96+   * *
     -   *
     -   *                   *
     -                 * *   *       * * 2         *
     -               *     2 *       *
   84+           *                       *       *
     -                                 *
     -                 *                                   *
     -                   *
     -
   72+                   *         * *       2
     -                       *
     -                               *
     -                                                       *
     -
   60+
     -
     -                                       *
     -
       --------+---------+---------+---------+---------+-------AGE
            5.0      10.0      15.0      20.0      25.0
```

```
) PRINT C1 C2 C9 C10
W   AGE-W   PCI-W   LOGPCI-W   LOGAGE-W

1       0     100    1.85733    1.20412
2       0     100    1.85733    1.00000
3       0     100    1.94448    1.07918
4       0     100    1.74036    1.30103
5       0     100    1.93450    1.20412
6       0     100    1.92428    0.77815
7       0     100    1.96848    0.47712
8       0     100    1.88649    1.00000
9       0     100    1.88649    1.17609
0       0     100    1.80618    1.44716
1       0     100    1.94448    0.60206
2       0     100    1.83251    1.20412
3       0     100    1.94448    0.95424
4      16      72
5      10      72
6      12      88
7      20      55
8      16      86
9       6      84
0       3      93
1      10      77
2      15      77
3      28      64
4       4      88
5      16      68
6       9      88
```

LOG 16 = 1.20412

LOG 72 = 1.85733

∴ CHECK OK

```
 ) REGRESS C12 1 C11

 regression equation is
PCI-O = 1.98 - 0.0534 LOGAGE-O

dictor        Coef         Stdev     t-ratio
stant      1.98437       0.03734       53.14
AGE-O     -0.05338       0.03227       -1.65

 0.03907      R-sq = 16.3%      R-sq(adj) = 10.4%

lysis of Variance

RCE        DF          SS           MS
ression     1     0.004176     0.004176
or         14     0.021367     0.001526
al         15     0.025543

sual Observations
.LOGAGE-O  LOGPCI-O       Fit Stdev.Fit  Residual   St.Resid
     0.30   1.96379   1.96830   0.02808  -0.00451     -0.17 X
     1.08   1.84510   1.92676   0.00984  -0.08166     -2.16R

enotes an obs. with a large st. resid.
enotes an obs. whose X value gives it large influence.

 ) PLOT C12 VS C11

PCI-O-
     -              *
     -
1.960+     *                         *
     -                                    * 2
     -                                     *    *
     -                                  *
     -                                      *
1.920+                                          *
     -
     -                               *
     -                                             *
     -
1.880+
     -
     -
     -                                          2
     -                                  *
1.840+
      ----+---------+---------+---------+---------+---------+--LOGAGE-O
        0.25      0.50      0.75      1.00      1.25      1.50
```

```
 > REGRESS C14 1 C13

 regression equation is
PCI-I = 2.00 - 0.0705 LOGAGE-I

dictor        Coef          Stdev     t-ratio
stant       2.00405        0.01251     160.22
AGE-I      -0.07047        0.01294      -5.44

 0.009329     R-sq = 90.8%      R-sq(adj) = 87.7%

lysis of Variance

RCE        DF            SS            MS
ression     1     0.0025796     0.0025796
or          3     0.0002611     0.0000870
al          4     0.0028407


 > PLOT C14 VS C13

PCI-I-
     -
     -      *
1.975+
     -
     -
     -
     -
1.950+
     -
     -                                             *
     -                                    *      *
     -
1.925+
     -
     -
     -                                                     *
     -
1.900+
       +---------+---------+---------+---------+---------+------LOGAGE-I
    0.20      0.40      0.60      0.80      1.00      1.20
```

```
 > REGRESS C16 1 C15

 regression equation is
PCI = 2.01 - 0.0887 LOGAGE

dictor        Coef          Stdev     t-ratio
stant       2.00549        0.03023      66.34
AGE        -0.08868        0.02740      -3.24

 0.04832     R-sq = 24.7%      R-sq(adj) = 22.3%

lysis of Variance

RCE         DF          SS           MS
ression      1     0.024452     0.024452
or          32     0.074703     0.002334
al          33     0.099155

sual Observations
.  LOGAGE     LOGPCI         Fit  Stdev.Fit   Residual    St.Resid
     0.30    1.96379     1.97879    0.02241   -0.01500      -0.35 X
     1.30    1.74036     1.89011    0.01058   -0.14974      -3.18R
     0.30    1.98227     1.97879    0.02241    0.00348       0.08 X
     0.30    1.96848     1.97879    0.02241   -0.01031      -0.24 X

enotes an obs. with a large st. resid.
enotes an obs. whose X value gives it large influence.

 > PLOT C16 VS C15

     -       *
     -       *      *
1.960+       *                              *      2
     -                                 * *  *2    **     *
PCI  -                               *     *     * *
     -                          *                      *
     -                                 *          *       *
1.890+                                   *
     -
     -                                   *       *   2
     -                                      *   *
     -                                           *
1.820+
     -                                                     *
     -
     -
     -
1.750+
     -                                               *
       ----+---------+---------+---------+---------+---------+--LOGAGE
        0.25      0.50      0.75      1.00      1.25      1.50

)
```

Ø 1.04139

) INFO

UMN	NAME	COUNT
	AGE-W	13
	PCI-W	13
	AGE-O	16
	PCI-O	16
	AGE-I	5
	PCI-I	5
	AGE	34
	PCI	34
	LOGPCI-W	13
	LOGAGE-W	13
	LOGAGE-O	16
	LOGPCI-O	16
	LOGAGE-I	5
	LOGPCI-I	5
	LOGAGE	34
	LOGPCI	34

STANTS USED: NONE

) PRINT C9 C10 C11 C12 C13 C14

W	LOGPCI-W	LOGAGE-W	LOGAGE-O	LOGPCI-O	LOGAGE-I	LOGPCI-I
1	1.85733	1.20412	0.30103	1.96379	0.30103	1.98227
2	1.85733	1.00000	1.30103	1.85733	0.90309	1.93450
3	1.94448	1.07918	0.95424	1.90309	1.07918	1.93952
4	1.74036	1.30103	1.25527	1.95424	1.23045	1.90849
5	1.93450	1.20412	1.25527	1.95424	1.04139	1.93450
6	1.92428	0.77815	1.34242	1.91908		
7	1.96848	0.30103	1.25527	1.92942		
8	1.88649	1.00000	1.07918	1.84510		
9	1.85126	1.17609	0.47712	1.97772		
0	1.80618	1.44716	1.04139	1.93952		
1	1.94448	1.00000	1.07918	1.95904		
2	1.83251	1.20412	1.30103	1.85733		
3	1.94448	0.95424	1.20412	1.94939		
4			1.43136	1.89763		
5			1.36173	1.94448		
6			1.23045	1.94448		

```
 > REGRESS C9 1 C10

 regression equation is
PCI-W = 2.05 - 0.162 LOGAGE-W

dictor         Coef          Stdev     t-ratio
stant       2.05395        0.05680       36.16
AGE-W      -0.16185        0.05237       -3.09

 0.05132      R-sq = 46.5%      R-sq(adj) = 41.6%

lysis of Variance

RCE         DF            SS            MS
ression      1      0.025155      0.025155
or          11      0.028969      0.002634
al          12      0.054124

sual Observations
.LOGAGE-W  LOGPCI-W       Fit  Stdev.Fit   Residual    St.Resid
     1.30    1.7404    1.8434     0.0194    -0.1030      -2.17R
     0.30    1.9685    2.0052     0.0417    -0.0367      -1.23 X


enotes an obs. with a large st. resid.
enotes an obs. whose X value gives it large influence.

 > PLOT C9 VS C10

     -       *
1.960+
     -                                 * *  *
PCI-W-                                           *
     -                          *
     -
1.890+                                   *
     -
     -                                   *       *
     -                                          *
     -                                           *
1.820+
     -                                                     *
     -
     -
     -
1.750+
     -                                               *
     -
       ----+---------+---------+---------+---------+---------+--LOGAGE-W
        0.25      0.50      0.75      1.00      1.25      1.50
```

Thesis
W376
c.1

Weisenburger
Statistical evaluation of airport pavement condition survey data for Washington, Orgeon, and Idaho.